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SALMON SPAWNING GROUND SURVEYS IN THE BRISTOL BAY AREA, ALASKA, 1991

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ABSTRACT

Aerial surveys were conducted during 1991 in the Naknek-Kvichak, Egegik, Ugashik, Nushagak, and Togiak Districts of Bristol Bay, Alaska, to assess salmon escapement abundance and distribution. Alagnak River index counts totaled 277,589 sockeye, 2,531 chinook, and 64,300 chum salmon. Total sockeye salmon escapements estimated from tower counts for the Kvichak and Naknek Rivers were 4,222,788 and 3,578,508, respectively. The Naknek River sockeye count was the largest on record. Naknek River drainage index counts for chinook salmon yielded a total of 4,391 spawners. Egegik District index counts totaled 553 chinook, and 3,420 chum salmon. Streamside counts of chinook and chum salmon on Gertrude Creek were 14% greater and 52% less, respectively, than aerial survey counts made on the same date. Streamside counts of chinook and chum salmon on Whale Mountain Creek were 27% greater and 12% greater, respectively, than aerial survey counts made on the same date. The total sockeye salmon escapement estimated from tower counts for the Egegik River was 2,786,880, the largest tower count on record for this system. Ugashik District index counts totaled 24,710 sockeye (Dog Salmon and King Salmon Rivers), 2,400 chinook, and 13,820 chum salmon. Total sockeye and pink salmon escapements estimated from tower counts for the Ugashik River were 2,457,306 and 660, respectively. Spawning escapements of salmon in the Nushagak-Mulchatna River system were estimated using sonar at Portage Creek and totaled 495,106 sockeye, 135,054 chinook, 252,436 chum, 0 pink, and 41,153 coho salmon. Sockeye escapements were estimated from tower counts in the Wood and Igushik Rivers, and totaled 1,159,920 and 756,126. The sockeye escapement for the Igushik River was the third highest recorded for that system since 1972. The sockeye salmon escapement in the Togiak Lake system estimated from tower counts totaled 254,683, while aerial surveys of the Togiak River below the tower yielded an additional inriver escapement estimate of 23,720. The escapement estimate for sockeye salmon in Togiak River and Lake combined totaled 278,403. Sockeye salmon escapement in Kulukak Bay drainages, estimated from aerial surveys, was 23,940. Chinook and chum salmon escapements for the Togiak and Kulukak Rivers combined were estimated at 9,091 and 107,230, respectively.

KEY WORDS: Sockeye salmon, chinook salmon, chum salmon, pink salmon, coho salmon, Bristol Bay, spawning escapement enumeration, population estimation, aerial surveys, ground surveys

INTRODUCTION

Aerial surveys of salmon spawning streams have been conducted in Bristol Bay, Alaska, (Figure 1) for many years to provide biologists with information regarding the abundance and distribution of sockeye salmon (*Oncorhynchus nerka*), chinook salmon (*O. tshawytscha*), chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), and coho salmon (*O. kisutch*) escapements. This information supplements data gathered at counting towers on mainstem rivers, supplies data for time periods and species not covered by counting tower operations, and provides data for rivers where counting towers were not used. The data collected is used to: 1) evaluate escapement goals and escapement-return relationships; 2) assist in forecasting future returns; 3) identify and solve management problems relating to attainment of escapement goals. This report summarizes the 1991 salmon spawning ground surveys conducted in the Bristol Bay area.

METHODS

All survey flights were conducted from small fixed-wing, high-wing, wheeled aircraft (Super Cub, Cessna 180, or Cessna 185) chartered from local air charter companies and flown by experienced survey pilots. Several surveys in the Togiak National Wildlife Refuge (TNWR) were flown by refuge staff pilots in U.S. Fish and Wildlife Service (USFWS) aircraft. Fish were counted by Department of Fish and Game or USFWS biologists familiar with the streams and target species. Counts were made from low altitudes (200 to 400 feet) at air speeds of 50 to 80 mph. Polaroid sunglasses and aircraft positioning were used to minimize effects of glare off the water. Surveys were scheduled to coincide as closely as possible to the historic peak of spawning for the target species, taking into account weather, water conditions, and aircraft availability. Peak of spawning was defined as that point when the greatest number of spawning fish are occupying redds. Counts were registered on hand tally counters or tape recorded and then entered on survey data forms.

It is recognized that aerial spawning ground surveys account for only a portion of the known spawning populations (Evzerof, 1975; Nielson and Green, 1981; Rogers, 1984). At the time of each survey, some of the fish have yet to reach the spawning grounds, some have spawned and died, some are schooled, and others are misidentified or not seen. Methods used to interpret aerial survey index counts are described below for each commercial fishing district.

Naknek/Kvichak District

Aerial surveys were flown during late summer and fall to assess escapements of sockeye, chinook, and chum salmon in portions of the Naknek-Kvichak District. All major chinook spawning areas in the Naknek and Alagnak Rivers were surveyed (Figure 2). Salmon counts for these drainages were indices of the total number of each species present in the spawning area at the time of the survey. These counts were not expanded to represent an instantaneous population estimate based on subjective criteria available to the surveyor (expansions for unsurveyed portions of the drainage, expansions to compensate for areas of poor visibility, etc). Tower counts were used to obtain total sockeye salmon escapement estimates in the Kvichak and Naknek Rivers. A late summer survey of sockeye salmon spawning distribution was done for the Kvichak River system and results will be documented in a another report. All aerial survey counts were accomplished by ADF&G, Commercial Fisheries Division staff.

Egegik District

The Egegik River system contains two major river drainages: 1) Egegik River proper, draining Becharof Lake and nearby coastal lowlands, and 2) King Salmon River, draining runoff from the Kejulik Mountains and southern portions of Katmai National Park (Figure 3). These two rivers merge at the head of Egegik Bay near Egegik village.

No system-wide aerial surveys were flown for sockeye salmon in 1991. Aerial surveys were flown of all known chinook and chum salmon spawning areas in both the Egegik and King Salmon Rivers, and counts of both species were obtained concurrently. Due to budget constraints no aerial surveys were flown for coho salmon in the Egegik District drainages. Survey counts in the Egegik District reflect only the actual numbers of salmon sighted and should be considered an index of abundance only.

Attempts were made to compare salmon counts from aerial surveys with counts from ground surveys at Gertrude and Whale Mountain Creeks in the Egegik District. On both these creeks biologists from the United States Fish and Wildlife Service (USFWS) were conducting rainbow trout (*O. mykiss*) tagging studies during August and made counts of chinook and chum salmon on August 6, the date that ADF&G biologists aerially surveyed these creeks. The unexpanded ground and aerial counts were then compared.

Ugashik District

The Ugashik River system is comprised of four major drainages: (1) Ugashik River proper, draining Ugashik Lakes and nearby coastal lowlands, (2) Dog Salmon River, fed by glacial melt and runoff from peaks in the Aleutian Range, (3) King Salmon River, draining Mother Goose Lake and three major runoff tributaries, and (4) Dago Creek, draining a large area of coastal lowlands (Figure 4). All these drainages flow into the intertidal reaches of Ugashik River and Ugashik Bay.

Salmon counts in the Ugashik District reflect only the actual numbers of salmon sighted on the spawning grounds during the August 12 aerial surveys and should be considered as only an index of total abundance.

Nushagak District

Nushagak District is comprised of four major drainages: 1) Wood River, draining Grant, Kulik, Beverley, Nerka, and Aleknagik Lakes, 2) Nushagak River, draining the Tikchik Lakes and the Nuyakuk, upper Nushagak, and Mulchatna Rivers, 3) Igushik River, draining Ualik and Amanka Lakes, and 4) Snake River, draining Lake Nunavaugaluk (Figures 5 through 8). All these systems empty into Nushagak Bay.

Survey methods in the Nushagak District, and subsequent analysis of the data was consistent with methods described by Nelson (1979), Bucher (1981), and Russell, Bill and Bucher (1990).

Sockeye escapements in the Wood and Igushik Lake systems were estimated from counting towers, located at the outlet of the lowest lake of each system. Aerial surveys of the Wood River system have been flown annually to assess spawner distribution, but could not be completed in 1991 due to budget constraints. Lake beaches, which typically support over 40% of the spawning population of sockeye salmon, were surveyed by ADF&G, with funding from the University of Washington, Fisheries Research Institute. The department did fund a survey of the Agulowak and Agulukpak Rivers, two rivers that have traditionally supported most river-spawning sockeye in the Wood River system. Ground surveys were conducted on the major creeks and remaining rivers by staff of the University of Washington, Fisheries Research Institute.

Aerial surveying has been the only method used to estimate sockeye escapement and distribution in the Snake Lake system for the past several years. Although budget constraints would have precluded the department from conducting aerial surveys of the Snake Lake system in 1991, TNWR donated an aircraft and pilot for two surveys.

Aerial surveys have been conducted for the Igushik system in the past, however none have been conducted in recent years, and ordinarily no survey would have been conducted this year. As the 1991 sockeye run progressed, however, it became evident that escapement into the Igushik Lakes would greatly exceed the spawning goal for that system. TNWR contributions enabled complete survey coverage.

A hydroacoustic project, located approximately 32 km (20 miles) upstream from the Nushagak River mouth and below Portage Creek, was used to estimate escapement of all salmon species in the Nushagak River (Woolington *In press*). Although the sonar enumeration program is now considered to be reliable, aerial surveys have been conducted in key index areas of the Nushagak-Mulchatna drainage in recent years to verify hydroacoustic salmon counts and document the spawning distribution for all species of salmon. In 1991, however, surveys of the upper Nushagak and Mulchatna Rivers were not possible due to budget constraints. Funding provided by the owner of a sport fishing lodge enabled sockeye surveys to be flown in the Tikchik Lakes system. Ordinarily this system is not surveyed, but aerial counts were obtained in the Tikchik system this year due to the availability of funding and a high proportion of age-0. sockeye salmon in the escapement, which was also observed last year.

Peak aerial counts for sockeye salmon in the Wood, Igushik, Snake, and Tikchik Lakes systems have generally accounted for 50% (range: 29%-65%) of the actual escapements estimated at towers or weirs on those systems (Nelson, 1967 and 1979). In the Igushik, Snake, and Tikchik systems, peak aerial counts of sockeye salmon are typically expanded by a factor of 2.0 to estimate total escapement. However, other factors may be applied at the discretion of the surveyor depending on weather, visibility, and survey timing. In the Wood River system the sockeye salmon escapement for each spawning stream, beach, or river has historically been estimated using the proportion of fish observed at a given location relative to the total tower count. Different expansion factors have been assigned to each type of spawning habitat. For a more detailed description of the analysis of Wood River aerial survey counts, see Nelson (1973).

Paired aerial counts were made by the former (Wesley Bucher) and the present (Thomas Brookover) department surveyor in the Nushagak District during 1991 to ensure consistency in the data among years. Additionally, paired counts were obtained during surveys flown by the present department and the primary USFWS (Mark Lisac) surveyor within the Togiak National Wildlife Refuge (also see Methods described under Togiak District section).

Togiak District

Togiak District is comprised of two major drainages: 1) Togiak River, draining Togiak, Gechiak, Pungokepuk, and Ongivinuck Lakes as well as the Nayorurun and Kemuk Rivers (Figure 9), and 2) Kulukak River, draining Kulukak Lake (Figure 10). Various smaller systems within the District include Tithe Creek Ponds and the Quigmy, Matogak, Osviak, Slug, Negukthlik, and Ungalikthluk Rivers. The Kulukak River and Tithe Creek Ponds flow into Kulukak Bay, located in the eastern portion of the District, the Togiak and Quigmy Rivers flow into Togiak Bay, located in the middle of the District, and the Matogak, Osviak, and Slug Rivers flow into Hagemeister Straits and coastal waters in the western portion of the District (Figure 1).

Sockeye salmon escapement was estimated for the Togiak Lake system from a counting tower operated at the outlet of Togiak Lake. Abundance and distribution of spawning populations of sockeye salmon in the Togiak River and tributaries below the counting tower, as well as all other systems in the Togiak District, were estimated solely by aerial surveys. Abundance and distribution of chinook, chum, pink, and coho salmon were estimated entirely from aerial surveys.

Budget constraints would have precluded the department from conducting aerial surveys in the Togiak District this year. TNWR donated an aircraft and pilot for several surveys and funding for charter aircraft, enabling aerial surveys of spawning sockeye, chinook, chum, and coho salmon. Survey coverage was divided between a USFWS observer and the department observer. Several systems were flown with both surveyors aboard the same aircraft, and several surveys were duplicated with each observer in a separate aircraft, to compare counts.

Survey methods and data analysis used in Togiak District were similar to methods described by Nelson (1979), Bucher (1981), and Russell, Bill, and Bucher (1990). In recent years, budget shortfalls have necessitated conducting surveys between the periods of peak spawning for chinook and chum salmon, resulting in the application of greater expansion factors and reduced accuracy in escapement estimates for these species. Since funding was available from TNWR, aerial surveys in 1991 were conducted at the peak of spawning for each species, similar to the methods used by Nelson and Bucher in the late 1970's and early 1980's.

Aerial survey counts for sockeye salmon in the Togiak Lake system above the counting tower have generally accounted for 47% (range: 40%-50%) of the escapements estimated at the tower (Nelson, 1967). Therefore, aerial counts of sockeye salmon in systems without counting towers (i.e. Kulukak River and the mainstem and

tributaries of the Togiak River below the tower) were multiplied by 2.0 to estimate total escapement. Since 1980, aerial counts of chinook salmon in the Togiak District have typically been multiplied by 2.5 to estimate escapement. Chum escapements have, since 1968, generally been estimated by multiplying aerial counts by 2.0, as justified in Nelson (1968). An expansion factor of 3.0 was deemed most appropriate for coho salmon based on a streamlife study in the Gechiak River (Minard, 1986), and has been used for that species in all areas of the Togiak District since coho surveys were initiated in 1980. Expansion factors may be subjectively adjusted based on weather conditions, visibility, and survey timing with respect to the peak spawning activity.

RESULTS AND DISCUSSION

Naknek-Kvichak District

Sockeye salmon aerial surveys for the Alagnak River and its tributaries were conducted on August 9 and 19. The escapement index count totaled 277,589 sockeye for this system (Table 1). This count was the largest since 1980 (Table 2) and was 20% greater than the 1955-1990 mean of 230,802. It was approximately 50% greater than the desired escapement goal of 185,000. The actual total escapement into this system was probably even greater since the index count was not expanded to represent an estimate of total escapement. Total sockeye salmon escapements estimated from 1991 tower counts for the Kvichak and Naknek Rivers were 4,222,788 and 3,578,508 respectively (Table 2). The Naknek River sockeye escapement count was the largest ever documented for the river, surpassing the previous record of 2,644,698 set in 1980.

Chinook salmon aerial surveys were flown for the Naknek River drainage during the interval from July 30 - August 20 to assess the spawning peaks in each of the four main spawning component areas. Cumulatively, an index of 4,391 chinook was observed for the entire Naknek drainage. The largest components of this index were counts of 2,340 chinook in Big Creek on August 12, and 1,655 in the mainstem Naknek River on August 20 (Table 3). Over the period from 1981-1990 the Naknek drainage chinook index has ranged from a low of 2,710 in 1989 to a high of 11,730 in 1988 and has averaged 6,168 fish, so the 1991 index was below average.

The Alagnak River chinook escapement was surveyed on August 19 yielding an index of 2,531 fish (Table 3). Chinook salmon index counts for the Alagnak River drainage from 1981-1990 have ranged from a low of 1,720 in 1990 to a high of 6,090 in 1984 with an average of 3,765 fish, so the 1991 count was well below average. No

aerial estimates of chinook spawning in the Kvichak River were conducted in 1991.

Chum salmon were counted only during the August 19 Alagnak River aerial surveys. The Alagnak River has been the principal chum salmon producing drainage in the Naknek-Kvichak District. A total of 64,300 spawning chums were observed during the 1991 survey (Table 3).

No pink salmon surveys were flown in Naknek-Kvichak District drainages in 1991 as very few individuals of this species return to the district in odd-numbered years.

Escapement surveys targeting coho salmon were not flown in Naknek-Kvichak District during 1991 due to budget constraints.

Egegik District

The 1991 Egegik River sockeye escapement counted past the counting towers totaled 2,786,880 fish, the largest count on record for this system. Although no system-wide aerial surveys were flown, an additional 45 sockeye salmon were counted in King Salmon River tributaries. No surveys of the distribution of the record Egegik River sockeye escapement were flown due to budget constraints.

Aerial surveys of all known chinook spawning areas were conducted August 6 and yielded a total index count of 553 chinook salmon (Table 4). This was less than half the 1981-1990 mean index count of 1,284 chinook salmon. Comparative chinook index counts for the period 1981-1991 are presented in Table 5. The commercial harvest of chinook salmon in the Egegik District was also very small. Only 465 chinook salmon were landed, just 16% of the recent 20-year (1971-1990) mean harvest of 2,984 chinook. Thus it was apparent that the 1991 Egegik District chinook salmon run was well below average.

A total of 3,420 chum salmon were counted during surveys of all known spawning areas on August 6 (Table 6). Comparison of 1991 indices with those from prior years indicated that chum salmon escapement abundance was the lowest ever documented in the district (Table 7), far below the 1982-1990 average of 16,818. The 1991 commercial harvest of 71,313 chum salmon in Egegik District suggested the run was a little below average, but escapement was much smaller than expected. This also occurred in 1989 and 1990, but daily monitoring of the chum and chinook escapements into the King Salmon River cannot be done without either a weir or hydroacoustic equipment. Since the peak of the chum salmon run closely overlaps the peak of the sockeye salmon run, the much less abundant chum salmon resource has been exploited at a higher rate

by the commercial fishery in order to harvest the abundant sockeye salmon runs in recent years.

No pink salmon were observed in the Egegik River "rapids" during the August 6 surveys (Table 8). The commercial harvest totaled 121 fish. This was normal for an odd-numbered year.

Due to budget constraints no index counts of coho salmon escapement were made during 1991 (Table 10). The commercial coho salmon harvest in Egegik District totaled 46,500 fish, well above the 1971-1990 average of 24,600.

Streamside surveys of chinook and chum salmon in Gertrude and Whale Mountain Creeks conducted by USFWS personnell concurrent with ADF&G aerial surveys of these waters August 6 yielded interesting comparative estimates of fish abundance. Aerial counts of chinook in the two streams were 83 and 60, respectively, while ground level counts were 95 and 76, respectively. Ground level counts were 14% and 27% larger, respectively, than aerial indices. A conversion factor of 1.2 would need to be applied to aerial counts of chinook salmon to approximate overall streamside counts. Aerial counts of chum salmon in the same two streams totaled 990 and 1,500, respectively, while ground level counts totaled 521 and 1,673, respectively. Ground level counts were 53% less and 12% greater, respectively, than aerial counts. A conversion factor of 0.9 would need to be applied to aerial counts of chum salmon to approximate overall streamside counts.

Ugashik District

The 1991 sockeye escapement count past Ugashik River counting tower totaled 2,457,306 fish, the second largest escapement on record and more than three times the desired point goal of 700,000. No system-wide aerial surveys documenting the distribution of this large escapement were flown due to budget constraints, but an additional 12,500 and 12,195 sockeye salmon were counted in the Dog Salmon and King Salmon River drainages, respectively, on August 12 (Table 11).

Chinook salmon escapement surveys of Dog Salmon, King Salmon, and Ugashik River drainages were flown August 12, yielding index counts of 449, 1,860, and 53 chinook salmon, respectively (Table 12). The 1990 total index of 2,400 was 56% lower than the 1980-1990 mean index of 5,400 chinook salmon, and was the lowest annual index observed since comprehensive surveys were begun in 1983 (Table 13). The total chinook salmon run appears to have been well below average since only 1,365 chinook salmon were harvested commercially in 1991, the smallest commercial catch reported from this District since 1976.

Chum salmon were also counted during the aerial surveys of the Dog Salmon, King Salmon, and Ugashik River drainages on August 13, yielding a total index count of 13,820 chum salmon (Table 14). Surveys were thought to be near the peak of spawning abundance. The 1991 escapement index was slightly larger than that obtained in 1990 (Table 15) but was still far below the 1980-1990 mean index of 42,900. The commercial harvest of chum salmon totaled 56,700 fish, slightly above the 1971-1990 mean commercial harvest of 52,800 chum salmon.

The Ugashik District pink salmon run has historically been very small and almost nonexistent in odd-numbered years. Such was the case again in 1991. A total of 660 pinks were counted past Ugashik River tower (Table 16), and only two were reported caught commercially.

No aerial surveys targeting coho salmon were made in the Ugashik District drainages in 1991 due to budget constraints (Table 18). The commercial fishery harvested 45,000 cohos, well above the 1971-1990 average harvest of 21,700.

Nushagak District

Surveys were not comprehensive for all creeks and rivers this season, and surveys of the lake beaches were flown approximately one to two weeks late, based on the large number of carcasses observed on some beaches, most notably in Lake Nerka (Table 19). Aerial counts for the lake beaches, therefore, did not accurately reflect the number of spawners utilizing the beaches. Aerial and ground counts for the major creeks and interconnecting rivers were considered to be acceptable. Total survey counts in 1991 accounted for only 18.2% of the escapement estimate, the second lowest percentage in the history of aerial surveys for the Wood River system.

The 1991 Wood River tower count of 1,159,920 was above the escapement goal of 1,000,000 fish, and near the upper end of the desired escapement goal range of 1,200,000 (Table 20). Since aerial surveys were not comprehensive this season, specific proportions of sockeye spawners utilizing creeks and beaches were not documented. Spawning populations in major rivers were observed at the peak of spawning, and comprised only 19% of the total escapement. This was only the second year since 1965 in which the river component has comprised less than 20% of the escapement. Spawning in creeks appears to have been average overall, and slightly above average for lower lake creeks (Don Rogers, personal communication, 1991).

Abundance of spawning sockeye salmon in the Snake River drainage in 1991 was estimated to be 10,920 fish, the lowest escapement

estimate since 1983 (Tables 21 and 22). Aerial counts in all creeks draining into Snake Lake were well below average, as were counts on several beaches. Although counts for the Snake River to Eagle Creek Beach and the Southshore Beach were average, they were below levels observed on those beaches since 1984.

Sockeye salmon escapement into the Igushik Lakes system was estimated at 756,126 at the counting tower, close to four times greater than the escapement goal of 200,000 fish. Aerial surveys of the Igushik Lakes system were unable to document a large portion of the sockeye escapement estimated at the counting tower: the drainage-wide aerial count of 73,440 sockeye comprised only 10% of the tower count (Table 23). In addition, the 1991 aerial count was below the mean for years when surveys were routinely conducted. Surveys of Francis and Longarm Creeks and Ongoke River were late, and are conservative even with estimates of dead and schooled fish included. Two observers flew the Ualik and Amanka Lake beaches; survey timing appeared to be good, the two observer counts were similar, and therefore, the beach counts appear to be fairly accurate. Based on the quality of beach counts, and even though the survey counts of the creeks were minimal, it is probable that the Kathlene River supported a protracted spawning run through time, and only a small portion of the actual spawning population was observed.

The 1991 sockeye escapement into the Nushagak River drainage was estimated to be 495,106 fish at the Portage Creek sonar counter, 90% of the desired escapement goal of 550,000 (Woolington *In press*). Typically, the Tikchik Lakes system receives most sockeye salmon that enter the Nushagak River. The 1991 estimate for the Tikchik Lakes system of 266,000 fish (Table 24) represents 54% of the Nushagak sockeye salmon escapement, and is well below the average 1981-1988 tower count on the Nuyakuk River of 487,000 fish. This was the second year in a row in which the Tikchik Lake component of the Nushagak escapement was estimated to be lower than average. Also for the second year in a row, the percentage of age-0 sockeye salmon (most of which are thought to spawn in the upper Nushagak and Mulchatna Rivers) in the escapement sampled at the Portage Creek sonar site exceeded 44%. A factor of 2.5 was used to account for slightly late timing of beach surveys and slightly early timing of river surveys. Survey timing and conditions for the Tikchik Lake surveys were greatly improved over those of 1990, therefore the 1991 escapement estimate should be more accurate than that of 1990. No aerial surveys were conducted for the Nushagak/Mulchatna drainage during 1991 (Table 25).

Chinook salmon escapement into the Nushagak drainage was estimated to be 135,054 at the Portage Creek sonar counter in 1991, which is the largest chinook escapement since 1983 (Table 26). The 1991 escapement was nearly double the goal of 75,000, and exceeded the

1972-1991 and 1982-1991 averages by approximately 50%. No aerial surveys were conducted during 1991 (Table 27).

Chum salmon surveys were discontinued in the Nushagak District in 1980. Since that time, escapements have been estimated from the Portage Creek sonar project, which counted 252,436 chum salmon this season. This estimate was average for the period 1982-1991, but comprised only 72% of the escapement goal of 350,000 fish (Table 28).

Pink salmon escapement in odd-numbered years has typically been very small. No pink salmon were captured at the sonar counter at Portage Creek this year. Pink salmon escapements during even-numbered years in the Nushagak District can be quite large (Table 29). Aerial surveys have not been conducted for pink salmon in the Nushagak District in recent years, and 1991 was no exception.

The Nushagak coho escapement was estimated at 41,153, through August 21, only 20% of the escapement goal (150,000). No aerial surveys were conducted for coho salmon this season in the Nushagak District.

Togiak District

Weather and water conditions were good at the time of sockeye salmon surveys, so an expansion factor of 2.0 was used to estimate spawning escapement in all areas except the Negukthlik River, where a factor of 1.5 was used (Table 30). Sockeye salmon escapement for all sections of the Togiak River and its tributaries was estimated at 23,720 fish, slightly below the 1982-1991 average (Table 31). Escapement past the counting tower was estimated at 254,683, therefore the combined sockeye salmon escapement in Togiak River totaled 278,403. The spawning population in the Kulukak River Section, including Tithe Creek Ponds, totaled 23,900 sockeye salmon. This was 66% of the 1982-1991 average and 68% of the escapement goal of 35,000 fish. Peak sockeye counts were considerably less than the 1972-1991 average for Tithe Creek Ponds and the Ongivinuck and Slug Rivers, while counts were above average for the Matogak, Osviak, and Negukthlik Rivers (Tables 32 and 33). Sockeye salmon escapement for the entire district totaled 320,700 fish.

Survey conditions were good in all areas except the lower Togiak River from the mouth to the Gechiak River, for which an expansion factor of 3.0 was applied (Table 34). The chinook escapement for the Togiak River of 8,378, as well as the entire district escapement estimate of 12,667, were the largest observed since 1985. However the Togiak River escapement did not reach the goal of 10,000 for the sixth consecutive year, and the district

escapement was below the 1982-1991 average for the sixth consecutive year. The number of chinook spawners observed in the lower mainstem Togiak River from the mouth up to the Gechiak River was above the 1972-1991 average, but below average numbers were observed in the mainstem above the Ongivinuck River and in the tributaries (Table 35). Chinook counts in the Matogak and Osviak Rivers were below the 1972-1991 average, and the aerial count of chinook salmon in the Kulukak River was the lowest since at least 1972 (Table 36). Estimated escapement into the Kulukak River totaled 710 chinook, which was 71% of the goal. The peak count in the Negukthlik was the largest since 1983, and well above the 1972-1991 average. Timing for this system is generally assumed to coincide with other systems within Togiak District, as described in Nelson (1979). In 1991, however, a higher count occurred on August 21 with fish well distributed, compared to a survey on August 7, when many fish were observed still in large schools. Timing of spawning activity in all other areas was more typical for chinook salmon, and peaked during the week of August 1.

The chum salmon escapement for the entire district was estimated at 149,210 (Tables 28 and 37). Counts were obtained from the same surveys used to count chinook, and timing was good except in the Nayorurun, Kemuk, and Ongivinuck Rivers, where fair numbers of carcasses (up to 50% of live counts) were observed and an expansion factor of 2.5 was applied. Survey timing was fair in the Togiak River mainstem and lower tributaries. The district escapement was 70% of the 1982-1991 average, and the escapement estimate for the Togiak River (88,150) is less than 50% of the goal of 200,000. Peak counts of chum salmon in 1991 were below the 1972-1991 average in all major river systems surveyed in the Togiak District, except for Quigmy River which had an average escapement (Tables 38 and 39).

Although aerial surveys of coho salmon on the spawning grounds were conducted in the Togiak District this season, heavy rains and flooding did not permit a survey until October 16, well past the peak of spawning. Based on past similarities between aerial counts during the first week of September and aerial counts at the peak of spawning, aerial counts conducted September 6 were used as a base for estimating coho salmon escapement in the Togiak and Kulukak Rivers (Table 40). Estimated coho salmon escapement into the Togiak River was 25,560, about 50% of the goal of 50,000. Coho escapement into Kulukak River comprised 85% of that river's goal of 15,000. These escapement estimates were considered to be conservative, and although they may not be as accurate as estimates based on true peak counts, it is unlikely that the Togiak River coho salmon escapement came close to the goal (Tables 41 and 42). Spawning distribution in 1991 cannot be compared to other years since fish were not observed actively spawning.

Several aerial survey counts were conducted for sockeye salmon solely by USFWS staff during 1991 (Table 30). Comparable counts of

spawning salmon were obtained by two ADF&G observers (Tom Brookover and Wes Bucher) and by the principal ADF&G and USFWS observers (Tom Brookover and Mark Lisac) in 1991 (Tables 43 and 44). There was only an 8% difference between sockeye salmon counts of the two ADF&G observers. In general, ADF&G and USFWS observers had similar counts for chum, chinook and sockeye salmon.

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Table 1. Aerial survey counts of sockeye salmon, Alagnak River system, 1991.

System Location	Number of Fish				Percent of Total
	Spawning	Dead	Schooled	Total	
Nonvianuk River	0	0	0	0	0
Nonvianuk Lake:					
South Beach	0	0	700	700	0
North Beach	700	0	1,100	1,800	1
Kulik River	9,800	1,365	17,500	28,665	10
Kulik Lake:					
South Beach	0	0	200	200	0
North Beach	100	0	1,300	1,400	1
Alagnak River	0	0	0	0	0
Kukaklek Lake:					
South Beach	800	0	300	1,100	0
North Beach	400	0	200	600	0
Nanuktuk Creek	25,100	2,210	18,100	45,410	16
Battle River	10,700	1,220	13,700	25,620	9
Battle Lake:					
South Beach	450	0	100	550	0
North Beach	900	0	900	1,800	1
Spectacle Creek	57,200	3,966	75,000	136,166	49
Funnel Creek	25,500	978	7,100	33,578	12
Total	131,650	9,739	136,200	277,589	100

Table 2. Sockeye salmon total escapement estimates, Naknek-Kvichak District, 1955-1991. Estimates based on visual counts from towers unless otherwise noted.

Year	Escapement				Alagnak Percent of Total
	Kvichak	Naknek	Alagnak	Total	
1955	250,546	278,500	171,500[a]	700,546	24
1956	9,443,318	1,772,595	784,000[a]	11,999,913	7
1957	2,842,810	634,655	126,595	3,604,060	4
1958	534,785	278,118	94,650	907,553	10
1959	680,000	2,231,807	825,431	3,737,238	22
1960	14,630,000	828,381	1,240,530	16,698,911	7
1961	3,705,849	351,078	90,036	4,146,963	2
1962	2,580,884	723,066	90,630	3,394,580	3
1963	338,760	905,358	203,304	1,447,422	14
1964	957,120	1,349,604	248,700	2,555,424	10
1965	24,325,926	717,798	175,020	25,218,744	1
1966	3,775,184	1,016,445	174,336	4,965,965	4
1967	3,216,208	755,640	202,626	4,174,474	5
1968	2,557,440	1,023,222	193,872	3,774,534	5
1969	8,394,204	1,331,202	122,490	9,847,896	1
1970	13,935,306	732,502	177,060	14,844,868	1
1971	2,387,392	935,754	187,302	3,510,448	5
1972	1,009,962	586,518	151,188	1,747,668	9
1973	226,554	356,676	35,280	618,510	6
1974	4,433,844	1,241,058	214,848	5,889,750	4
1975	13,140,450	2,026,686	100,480	15,267,616	1
1976	1,965,282	1,320,750	81,822	3,367,854	2
1977	1,341,144	1,085,856	100,000[a]	2,527,000	4
1978	4,149,288	813,378	229,400[a]	5,192,066	4
1979	11,218,434	925,362	294,200[a]	12,437,996	2
1980	22,505,268	2,644,698	297,900[a]	25,447,866	1
1981	1,754,358	1,796,220	82,210[a]	3,632,788	2
1982	1,134,840	1,155,552	239,300[a]	2,529,692	9
1983	3,569,982	888,294	96,220[a]	4,554,496	2
1984	10,490,670	1,242,474	215,370[a]	11,948,514	2
1985	7,211,046	1,849,938	118,030[a]	9,179,014	1
1986	1,179,322	1,977,645	230,180[a]	3,387,147	7
1987	6,065,880	1,061,806	154,210[a]	7,281,896	2
1988	4,065,216	1,037,862	194,630[a]	5,297,708	4
1989	8,317,500	1,161,984	196,760[a]	9,676,244	2
1990	6,970,020	2,092,578	168,760[a]	9,231,358	2
1991	4,222,788	3,578,508	277,589[a]	8,078,885	3
Mean	5,662,908	1,208,367	232,066	7,103,341	3

[a]Aerial survey counts.

Table 3. Aerial survey counts of chinook, chum, pink, and coho salmon, Naknek-Kvichak District, 1991.

Location	Survey Date	Number of Salmon			
		Chinook	Chum	Pink	Coho
Kvichak River	None				
Alagnak River	Aug. 19	2,531	64,300		800[a]
Naknek River:					
Paul's Creek	July 30	121	5		
King Salmon Creek	Aug. 05	275	80		
Big Creek	Aug. 12	2,340			
Mainstem Naknek R.	Aug. 20	1,655			350[a]
Total		6,922	64,385	0	1,150

[a]Incidental observation.

Table 4. Aerial survey peak counts of chinook salmon escapement, Egegik District, 1991.

Location	Survey Date	Number of Chinook Salmon
Egegik River	July 22	0[a]
Shosky Creek	Aug. 06	62
Whale Mountain Creek	Aug. 06	60
Mossy Creek	Aug. 06	30
Mink Creek	Aug. 06	33
Gertrude Creek	Aug. 06	83
Kaye's Creek	Aug. 06	117
Takayoto Creek	Aug. 06	95[b]
Angle Creek	Aug. 06	
Contact Creek	Aug. 06	73[b]
Mainstem King Salmon River	Aug. 06	
Total		553

[a]Tower counts.
[b]No counts made due to murky water.

Table 5. Aerial survey index counts of chinook salmon escapement, Egegik District, 1981-1991.

Year	Egegik River	Shosky Creek	Gertrude Creek	Contact Creek	Takayoto Creek	Kaye's Creek	Other	Total
1981			515					515
1982	300		900	300				1,500
1983			860	375	380			1,615
1984	40	300	600	110	350			1,400
1985	75	80	260	95	315	230	25	1,080
1986	65	150	150	18	40	46	63	532[a]
1987	15	174	408	88	232	284	78	1,279
1988	50	151	248	110	177	120	12	868
1989	14	90	310	100	300	120	63	997
1990	24[b]	85	260	205	175	175	44	968
1991	0[b]	62	83	73	95	117	123	553
Mean	65	137	418	147	229	156	58	1,210[c]

[a]Survey done 10 to 14 days later than normal.
[b]Tower counts.
[c]Sum of mean indices for all locations.

Table 6. Aerial survey peak counts of chum salmon escapement, Egegik District, 1991.

Location	Survey Dates	Number of Chum Salmon
Egegik River	July 22	0
Shosky Creek	Aug. 06	0
Whale Mountain Creek	Aug. 06	1,500
Mossy Creek	Aug. 06	70
Mink Creek	Aug. 06	100
Gertrude Creek	Aug. 06	990
Kaye's Creek	Aug. 06	280
Takayoto Creek	Aug. 06	0[a]
Angle Creek	Aug. 06	
Contact Creek	Aug. 06	480[a]
Mainstem King Salmon River	Aug. 06	
Total		3,420

[a]No counts made due to murky water.

Table 7. Aerial survey index counts of chum salmon escapement, Egegik District, 1982-1991.

Year	Egegik River	Whale Mountain Creek	Gertrude Creek	Contact Creek	Takayoto Creek	Kaye's Creek	Other	Total
1982			12,000	2,000				14,000
1983			5,000	6,000	3,500			14,500
1984	800		13,000	10,000	2,400		200	26,400
1985	400	600	2,600	500	0	800	285	5,185
1986	0	6,025	140	15	5	3	25	6,213[a]
1987	150	19,000	3,770	2,850	0	2,780	1,016	29,566
1988	500	4,400	5,200	3,200	0	1,600	200	15,100
1989	0	5,200	1,100	200	0	0	150	6,650
1990	72[b]	4,875[c]	2,975[c]	1,050[c]	0	80	150	9,202
1991	0	1,500	990	480	0	280	170	3,420
Mean	240	5,943	4,679	2,630	656	792	275	15,215[d]

[a]Survey done 10 to 14 days later than normal.
[b]Tower counts.
[c]Total derived by adding Aug. 02 count to one half the counts obtained on Aug. 07, 12, 17, and 28.
[d]Sum of mean indices for all locations.

Table 8. Aerial survey index counts of pink salmon escapement, Egegik District, 1982-1991.

Year	Number of Surveys	Pink Salmon Count	Comments
1982	2	15,000	Spawning in Egegik River "Rapids" on Aug. 26
1983	0	58	Counted during float trip of Gertrude Creek.
1984	3	17,000	Peak count for Egegik River was 13,000 on Aug. 31.
1985	3	0	
1986	1	2,500	Count made Aug. 19.
1987	6	0	
1988	6	23,000	Peak count made Sept. 7.
1989	8	300	
1990	6	17,000	Peak count made on August 23.
1991	1	0	

Table 9. Aerial survey index counts of coho salmon escapement, Egegik District, 1991. All coho salmon observed were either migrating or schooled downstream of spawning areas.

Survey Date	Survey Locations			Total
	Egegik River	Gertrude Creek	Whale Mountain Creek	
No surveys conducted in 1991.				

Table 10. Aerial survey index counts of coho salmon escapement, Egegik District, 1981-1991.

Year	Number of Surveys	Coho Salmon Count	Comments
1981	1	4,000	Only Becharof tributaries surveyed[a]
1982	1	20,000	Surveyed on Aug. 20
1983	0		No surveys done
1984	3	43,225	40,000 counted in Egegik Lagoon on Aug. 15
1985	3	5,260	Peak survey on Aug. 26
1986	1	12,575	Surveyed Aug. 19
1987	6	6,930	Included King Salmon River and tributaries
1988	6	13,715	Included King Salmon River and tributaries
1989	9	4,485	Included Gertrude and Whale Mountain Creeks
1990	7	13,400	Peak survey on Aug. 17
1991	0	220	Incidental observation made Aug. 06.

[a]Surveys done by USFWS personnel.

Table 11. Aerial survey peak counts of sockeye salmon escapement, King Salmon and Dog Salmon Rivers, Ugashik District, 1991.

Location	Survey Date	Number of Sockeye Salmon
Ugashik River:		
Grassy Creek	Aug. 12	15
Subtotal		15
King Salmon River:		
Needle Lake	Aug. 12	1,600
Mother Goose Lake	Aug. 12	70
Painter Creek	Aug. 12	825
Mainstem King Salmon River	Aug. 12	9,700
Subtotal		12,195
Dog Salmon River:		
Figure-Eight Creek	Aug. 12	6,000
Goblet Creek	Aug. 12	0
Oldham Creek	Aug. 12	6,100
Wandering Creek	Aug. 12	250
Mainstem Dog Salmon River	Aug. 12	150
Subtotal		12,500
Grand Total		24,710

Table 12. Aerial survey peak counts of chinook salmon escapement, Ugashik District, 1991.

Location	Survey Date	Number of Chinook Salmon
King Salmon River:		
Old Creek	Aug. 12	420
Pumice Creek	Aug. 12	375
Painter Creek	Aug. 12	365
Mainstem King Salmon River	Aug. 12	700
Mother Goose Lake	Aug. 12	0
Indecision Creek	Aug. 12	0[a]
Volcano Creek	Aug. 12	
Subtotal		1,860
Dog Salmon River:		
Figure-Eight Creek	Aug. 12	430
Goblet Creek	Aug. 12	14
Oldham Creek	Aug. 12	0
Wandering Creek	Aug. 12	5
Mainstem Dog Salmon River	Aug. 12	0
Subtotal	Aug. 12	449
Ugashik River:		
Mainstem Ugashik River	July 28	78[b]
Mainstem Ugashik River	Aug. 12	40
Grassy Creek	Aug. 12	13
Subtotal		91[c]
Grand Total		2,400

[a]No counts made due to murky water.
[b]Tower count.
[c]Used tower count in computing total.

Table 13. Aerial survey index counts of chinook salmon escapement, Ugashik District, 1980-1991.

Year	Ugashik River	Dog Salmon River[a]	King Salmon River	Painter Creek	Pumice Creek	Old Creek	Total
1980			900	1,000			1,900
1981			50	300			350
1982			700	700			1,400
1983	50	965	525	635	1,800	660	4,635
1984		840	4,100	1,880	1,100	880	8,800
1985	50	560	4,600	410	930	410	6,960
1986	54	252	1,777	646	705	739	4,173
1987	30	751	981	1,051	1,602	1,155	5,570
1988	105[b]	900	5,820	1,170	1,025	660	9,680
1989	70[b]	848	1,670	1,030	510	520	4,648
1990	65[b]	540	1,500	590	450	610	3,755
1991	91[b,c]	449	700	365	375	420	2,400
Mean	64	678	1,944	815	944	673	5,118[d]

[a]Includes Figure Eight, Goblet, Oldham, & Wandering Creeks.
[b]Survey included Grassy Creek.
[c]Includes Ugashik River tower count.
[d]Sum of mean indices for all locations.

Table 14. Aerial survey peak counts of chum salmon escapement, Ugashik District, 1991.

Location	Survey Date	Number of Chum Salmon
King Salmon River:		
Old Creek	Aug. 12	2,525
Pumice Creek	Aug. 12	2,550
Painter Creek	Aug. 12	750
Mainstem King Salmon River	Aug. 12	7,400
Mother Goose Lake	Aug. 12	20
Indecision Creek	Aug. 12	10
Needle Lake	Aug. 12	100
Subtotal		13,355
Dog Salmon River:		
Figure-Eight Creek	Aug. 12	40
Goblet Creek	Aug. 12	0
Oldham Creek	Aug. 12	50
Wandering Creek	Aug. 12	150
Mainstem Dog Salmon River	Aug. 12	0
Subtotal		240
Ugashik River:		
Mainstem Ugashik River	Aug. 12	150
Grassy Creek	Aug. 12	75
Subtotal		225
Grand Total		13,820

Table 15. Aerial survey index counts of chum salmon escapement, Ugashik District, 1980-1991.

Year	Ugashik River	Dog Salmon River [a]	King Salmon River	Painter Creek	Pumice Creek	Old Creek	Other	Total
1980			7,000	3,000				10,000
1981			200					200
1982			19,000	35,000			650	54,650
1983		3,150	2,700	4,000	20,000[b]	3,300		33,150
1984		750	119,000	16,000	16,000	14,500	2,500	168,750
1985		350	20,000	1,925	6,000	670	300	29,245
1986		120	8,650	1,200	2,000	630	125	12,725
1987	100	340	9,750	2,290	10,340	2,090	40	24,950
1988	500[c]	2,290	25,000	10,500	11,650	5,800	950	56,690
1989	570[c]	1,005	7,500	3,700	2,200	2,010	625	17,610
1990	300[c]	170	7,600	1,150	1,630	410	10	11,270
1991	225[c]	240	7,400	750	2,550	2,525	130	13,355
Mean	339	935	19,483	7,229	8,041	3,548	592	40,167[d]

[a]Includes Figure Eight, Goblet, Oldham, & Wandering Creeks.
[b]Ground survey of Pumice Creek done from boat.
[c]Survey included Grassy Creek.
[d]Sum of mean indices for all locations.

Table 16. Aerial survey index counts of pink salmon escapement, Ugashik District, 1980-1991.

Year	Number of Surveys	Pink Salmon Count	Comments
1980	1	2,000	
1982	1	6,000	4,000 in King Salmon River, 2,000 in Painter Creek
1983	2	003	Survey of Dog Salmon River done by done by USFWS
1984	3	656	650 counted in King Salmon River during Sept. 21 float trip
1985	3	0	
1986	1	350	Observed in King Salmon River on Aug. 19
1987	2	1	
1988	7	2,800	Peak count on Aug. 23; 2,000 in King Salmon River
1989	8	50	Observed in Ugashik River on August 9
1990	5	2,000	Peak count on Aug. 13
1991	0	660	Ugashik River tower count.

Table 17. Aerial survey index counts of coho salmon escapement, Ugashik District, 1991. All coho salmon observed were either migrating or schooled downstream of spawning areas.

Survey Date	Survey Locations			Total
	Ugashik River	Dog Salmon River	King Salmon River	

No surveys conducted in 1991.

Table 18. Aerial survey index counts of coho salmon escapement, Ugashik District, 1981-1991.

Year	Number of Surveys	Coho Salmon Count	Comments
1981	1	13,300	Surveyed on Sept. 7
1982	1	10,000	Surveyed Aug. 26
1983	0		
1984	1	6,100	Surveyed on Aug. 31
1985	2	18,880	16,500 in King Salmon River on Sept. 12
1986	2	8,455	Surveyed on Aug. 19 and 25
1987	2	17,000	16,700 in King Salmon River on Aug. 23
1988	7	28,280	12,900 in King Salmon River Sept. 7
1989	4	11,515	7,615 observed on Aug. 14
1990	5	12,610	
1991	0	400	Incidental observation made Aug. 12

Table 19. Peak aerial live counts and total escapement estimates of sockeye salmon, Wood River system, 1991.[a]

Area	Aerial Counts[b] Date	Aerial Counts[b] Number	Total Escapement Estimate Number	Total Escapement Estimate Percent
Wood River	8/26	3,400	10,400	0.9
Lake Aleknagik				
Eagle Creek	8/10	670[c]		
Hansen Creek	8/05	8,930[c]		
Happy Creek	8/08	10,620[c]		
Bear Creek	8/07	5,600[c]		
Yako Creek	8/03	3,430[c]		
Whitefish Creeks		-		
Ice Creek	8/09	19,580[c,d]		
Mission Creek	8/17	1,840[c]		
Sunshine Creek		-		
Northshore Beaches	9/10	1,950		
Southshore Beaches	9/10	30		
Yako Beach	9/10	1,000		
Youth Creek		-		
Total		53,650		
Agulowak River & lower River Bay	8/26	86,000	145,000	12.5
Lake Nerka				
Fenno Creek	8/11	590[c]		
Upper River Bay Beaches, NW	9/10	600		
Upper River Bay Beaches, SE	9/10	1,600		
Allan Cr. to Ross Cr. Beaches	9/10	2,100		
Pike Creek		-		
Stovall Creek	8/23	450[c,d]		
Bear Creek		-		
Teal Creek		-		
N4 to River Bay Beach	9/10	260		
N4-N6 Beach	9/10	700		
Pick Creek Beach	9/10	0		
Pick Creek	8/12	3,160[c]		
Elva Creek Beach	9/10	200		
Elva Creek	8/26	20[c]		
Amakuk Arm Beaches	9/10	150		
Amakuk Arm Beach - Ott's Bay Beach	9/10	10		
Ott's Bay Beaches	9/10	430		
Kema Creek	8/21	510[c,d]		
Kema Creek Lake Beaches	9/10	0[d]		
Hidden Lake Creek	8/20	1,110[c]		
Hidden Lake Beaches		-		
Anvil Bay Beaches	9/10	2,500		
Anvil Bay Beach - Elbow Pt. Beach	9/10	300		
Elbow Pt. Beach - Lynx Cr. Beach	9/10	720		
Lynx Cr.- Teal Cr. Beaches	9/10	100		
Lynx Creek	8/22	920[c]		
Lynx Lake Beaches	9/10	210		
Total		16,640		

(continued)

Table 19. (page 2 of 3)

Area	Aerial Counts[b] Date	Number	Total Escapement Estimate Number	Percent
Little Togiak River	8/30	2,280[c]	3,800	0.3
Little Togiak Lake				
Northshore Beaches	9/10	550		
Southshore Beaches	9/10	230		
D Slough Beach	9/10	500		
Total		1,280		
Agulukpak River	8/26	34,000	57,000	4.9
Lake Beverley				
Hardluck Bay Beaches	9/10	2,700		
Sam's Beach	9/10	380		
Golden Horn Beaches	9/10	40		
Silver Horn Beaches	9/10	2,500		
B12 & B9 Beaches	9/10	3,250		
Tsun Creek		-		
Moose Creek	8/13	1,430[c,d]		
Hope Creek		-		
Hope Creek Lake Beach	9/10	0		
Total		10,300		
Peace River		-	1,200[e]	0.1
Lake Mikchalk				
Narrows	9/10	0		
Northshore Beaches	9/10	650		
Southshore Beaches	9/10	0		
Total		650		
Wind River	8/25	300[c]	600	0.1
Lake Kulik				
K5 Creek - Grant River Beaches	9/10	0		
Grant River to K2 Creek Beaches	9/10	1,600		
Southshore Beaches	9/10	440		
K1 and K2 Creeks		-		
Total		2,040		
Grant River	8/25	970[c,d]	3,000	0.3
Grand Total		211,510	1,159,900	19.0

[a] Aerial surveys of beach spawning areas were late and do not represent a peak count.
[b] All counts rounded to nearest 10 fish.
[c] Ground survey counts by F.R.I. personnel (only live spawners were included).
[d] Total spawning area not counted.
[e] Proportional estimate based on previous surveys.

Table 20. Spawner distribution and total escapement estimates of sockeye salmon, Wood River system, 1959-1991.

Year	Spawner Distribution (%)			Total Escapement[a]
	Creeks	Beaches	Rivers	
1959	32.8	50.3	16.9	2,209,300
1960	27.4	55.5	17.1	1,016,100
1961	11.4	32.3	56.3	460,700
1962	24.0	65.2	10.8	873,900
1963	12.1	68.5	19.4	721,400
1964	18.9	64.0	17.1	1,076,100
1965	40.6	11.1	48.3	675,100
1966	16.4	54.9	28.7	1,208,700
1967	9.3	66.2	24.5	515,800
1968	9.9	50.8	39.3	649,300
1969	8.6	42.4	49.0	604,300
1970	14.0	52.4	33.6	1,162,000
1971	11.2	56.8	32.0	851,200
1972	17.4	45.1	37.5	430,600
1973	11.5	23.9	64.6	330,500
1974	14.1	63.9	22.0	1,708,800
1975	14.5	34.4	51.1	1,270,100
1976	12.7	33.5	53.8	817,000
1977	11.3	39.5	49.2	561,800
1978	14.2	51.3	34.5	2,267,200
1979	7.3	60.4	32.3	1,706,400
1980	20.8	24.5	54.7	2,969,000
1981	23.0	20.7	56.3	1,233,000
1982	14.0	17.2	68.8	976,400
1983	14.3	60.9	24.8	1,361,000
1984	11.4	27.6	61.0	1,002,800
1985	18.6	22.2	59.1	939,000
1986	16.1	23.3	60.6	819,000
1987	27.6	56.1	16.3	1,337,000
1988	31.0	44.4	24.6	866,800
1989	19.6	28.9	51.5	1,186,400
1990				1,069,400
1991			19.0	1,159,900
Mean	17.3	43.5	38.6	1,092,000

[a]Estimated from Wood River tower counts rounded to the nearest hundred.

Table 21. Peak aerial live counts and total escapement estimates of sockeye salmon, Lake Nunavaugaluk drainage, 1991.

	Aerial Counts[a]		Total Escapement Estimate	
Stream	Date	Number	Factor[b]	Number
Snake River	8/26	120	2	240
Snake R. to Eagle Cr. Beaches	8/26	2,050	2	4,100
Eagle Creek	8/12	50	2	100
Eagle Lake	8/12	340	2	680
Westshore Beaches	8/26	1,480	2	2,960
Killian Creek	8/12	240	2	480
Eastshore Beaches	8/26	870	2	1,740
East Creek	8/12	10	2	20
Southshore Beaches	8/26	300	2	600
Total		5,460		10,920

[a]All counts rounded to nearest 10 fish.
[b]Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.

Table 22. Peak aerial live counts of sockeye salmon, Lake Nunavaugaluk drainage, 1972-1991.

Year	Snake River	Snake R.-Eagle Cr. Beach	Eagle Creek	Eagle Lake	Westshore Beach	Killian Creek	Eastshore Beach	East Creek	Southshore Beach	Total
1972		100	20	20	280	300	280	20	0	1,020
1973	20	50	10	30	210	70	130	0	20	540
1974	60	1,750	130	220	4,220	2,100	2,710	70	160	11,420
1975	80	1,200	90	260	1,250	780	710	0	100	4,470
1976	40	3,000	240		2,820	470	1,270		220	8,060
1977	410	1,520	90	120	2,690	650	1,430		50	6,960
1978	100	1,400	110	180	5,510	1,700	1,630		150	10,780
1979[a]										
1980[a]										
1981[a]										
1982	300	1,220	150	500	1,170	900	1,470	100	10	5,820
1983	0	560			400	110	470	0	10	1,550
1984	500	3,980	800	0	2,570	2,200	3,830	1,600	1,440	16,920
1985	100	4,070	0	700	5,040	3,600	2,240	1,200	490	17,440
1986		2,900	500	690	1,600	400	840	1,400	60	8,390
1987[a]										
1988[a]										
1989		2,800	1,000		5,290	1,200	2,060	700	980	14,030
1990	30	2,840	250	300	4,300	2,600	3,280	200	620	14,420
1991	120	2,050	50	340	1,480	240	870	10	300	5,460
Mean	147	1,963	246	280	2,589	1,155	1,548	442	307	8,677[b]
Percent	1.7	22.6	2.8	3.2	29.8	13.3	17.8	5.1	3.5	100.0

[a]No survey conducted.
[b]Sum of means for all areas.

Table 23. Peak aerial live counts of sockeye salmon, Igushik Lakes system, 1991.

	Date	Aerial Count	Range[a]	Mean[b]
Lake Amanka				
Longarm Creek	8/12	2,900[c]	100 - 18,000	5,100
Middle Creek			30 - 1,500	430
South Creek			10 - 2,500	900
Amanka Beaches	8/26	1,740	60 - 15,010	1,050
Subtotal		4,640		7,480
Kathlene River	8/21	21,000[c]	1,740 - 47,000	21,900
Ongoke River	8/12	19,400[c]	340 - 50,800	16,000
Subtotal		40,400		37,900
Lake Ualik				
Francis Creek	8/12	20,500[c]	700 - 48,000	13,800
Westshore Creeks			100 - 2,500	1,250
Westshore Beeaches	8/26	5,800	2,210 - 120,000	44,500
Eastshore Creeks			0 - 500	300
Eastshore Beaches	8/26	2,100	190 - 17,600	4,000
Subtotal		28,400		63,850
Total		73,440		109,230

[a]Range includes all aerial counts conducted from 1954 - 1991.
[b]Mean includes all aerial counts conducted from 1954 -1966. Surveys conducted in other years due to unusually large escapements were not included.
[c]Surveys were conducted after the peak of spawning had occured and did not accurately assess spawning population; counts were adjusted to include schooled and dead fish observed.

Table 24. Peak aerial counts and total escapement estimates of sockeye salmon, Tikchik Lakes system, 1991.

Area	Date	Aerial Counts			Mean Live Count[a]	Factor[b]	Escapement Estimate
		Live	Dead	Total			
Tikchik Lake							
Creek A	8/5	2,650	70	2,720	2,244		
Creek B	8/5	240	0	240	3,958		
Creek C	8/5	1,350	20	1,370	73		
Subtotal		4,240	90	4,330	6,275	2.5	10,600
Tikchik River							
Mainstem	8/5	84,170	1,600	85,770	14,359		
Cow Creek	8/5	2,600		2,600	4,800		
Koneruk Creek					0		
Subtotal		86,770	1,600	88,370	19,159	2.5	216,925
Nuyakuk Lake							
Northshore Beach	8/26	610	60	670	1,738		
Southshore Beach	8/26	290	0	290	3,170		
Portage Arm	8/26	40	0	40	566		
Mirror Bay	8/26	260	0	260	3,353		
Rapids	8/5	5,400	0	5,400	1,630		
Subtotal		6,600	60	6,660	10,557	2.5	16,500
Lake Chauekuktuli							
Creek #1	8/5	200		200	63		
Allen River Beach	8/5	7,100		7,100	16,435		
Allen River	8/5	900		900	366		
Northshore Beach	8/26	720		720	2,856		
Southshore Beach	8/26	60		60	424		
Shadow Bay	8/26	0		0	0		
Subtotal		8,980	0	8,980	20,143	2.5	22,450
Total		106,590	1,750	108,340	56,134		266,475[c]

[a]Includes live counts from all spawning ground surveys from 1958 - 1966, and 1974. Surveys conducted in other years due to unusally large escapements were not included.

[b]Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.

[c]Total escapement estimate does not include an estimate for Koneruk Creek, which accounts for an average of 6% of the Tikchik Lake system escapement.

Table 25. Peak aerial live counts of sockeye salmon in selected index streams and portions of the Nushagak and Mulchatna Rivers, 1977-1991.

Year	Muklung River	Iowithla River	Klutispaw River	King Salmon River	Stuyahok River	Koktuli River	Nushagak River[a]	Mulchatna River[b]	Total
1977	11,900	4,700	500	14,100	800	19,700	68,700	16,700[c]	137,100[c]
78	1,700	100	0	5,800	300	4,700	11,400	7,400	31,400
79	6,300	400	0	4,800	600	8,400	16,000	9,200	45,700
80	5,000	1,100[c]	100	16,100	5,200	14,300	14,600	7,800[c]	64,200[c]
81	2,100	700	100	11,500	800	9,900	6,300	4,400[c]	35,800[c]
1982	3,300	300	0	1,100	1,000	4,700	400	1,500[c]	12,300[c]
83	2,300	200	0	6,300	2,100	8,100	6,900	2,200	28,100
84	2,500	2,300	100	12,900	3,000	12,300	32,100	2,300	67,500
85	2,400	600	0	8,600	600	4,700	6,900	3,300[c]	27,100[c]
86	2,500	500	0	18,300	3,700	9,100	26,500[c]	8,400[c]	69,100[c]
1987	8,200	0	0	14,200	1,100[d]	3,500[d]	21,000[c]	6,700[c]	54,700[c]
88	2,100	2,100	0	8,400	2,500	13,800	10,400	2,700	42,000
89	-	-	-	-	1,300[d]	3,000[d]	-	-	-
90	9,000	0	200	9,000	500	11,100	3,900	2,200	35,900
91[e]									
Mean[f]	4,560	990	80	10,090	1,680	9,090	16,150	4,330	46,970
Percent	9.7	2.1	0.2	21.5	3.6	19.4	34.4	9.2	100.0

[a]Includes that section of Nushagak River between Nuyakuk River and King Salmon River.
[b]Includes that section of Mulchatna River between Koktuli River and Mosquito Creek.
[c]These numbers are proportional estimates rather than aerial live counts and are based on the mean percentage of fish counted in these areas during years in which aerial coverage was complete (1978, 1979, 1983, and 1984).
[d]Minimal estimate - very poor survey conditions. These numbers are included in the mean.
[e]No surveys conducted.
[f]Includes only those years in which aerial coverage was complete for the specific area.

Table 26. Inshore commercial catch and escapement of chinook salmon in the Nushagak and Togiak Districts, in numbers of fish, Bristol Bay, 1972-1991.[a]

Year	Nushagak District			Togiak District		
	Catch	Escapement[b]	Total Run	Catch	Escapement[c]	Total Run
1972	46,045	25,000	71,045	19,976	14,000	33,976
73	30,470	35,000	65,470	10,856	11,000	21,856
74	32,053	70,000	102,053	10,798	15,000	25,798
75	21,454	70,000	91,454	7,226	11,000	18,226
76	60,684	100,000	160,684	29,744	14,000	43,744
1977	85,074	65,000	150,074	35,218	20,000	55,218
78	118,548	130,000	248,548	57,000	40,000	97,000
79	157,321	95,000	252,321	30,022	20,000	50,022
80	64,958	141,000	205,958	12,543	12,000	24,543
81	193,461	150,000	343,461	23,911	27,000	50,911
1982	195,287	147,000	342,287	33,786	17,000	50,786
83	137,123	162,000	299,123	38,497	22,000	60,497
84	61,378	81,000	142,378	22,179	26,000	48,179
85	67,783	116,000	183,783	37,106	14,000	51,106
86	65,783	43,434	109,217	19,880	8,000[d]	27,880
1987	45,983	84,309	130,292	17,217	11,000	28,217
88	16,648	56,905	73,553	15,606	10,000	25,606
89	17,637	78,302	95,939	11,366	10,739	22,105
90	14,092[e]	63,955	78,047	12,241[e]	9,107	21,348
91	22,898[e]	135,054	157,952	7,088[e]	12,667	19,755
20-Year Ave.	72,734	92,448	165,182	22,613	16,226	38,839
1972-81 Ave.	81,007	88,100	169,107	23,729	18,400	42,129
1982-91 Ave.	64,461	96,796	161,257	21,497	14,051	35,548

[a]Escapement estimates supersede those previously reported.
[b]Escapements were estimated from the following:
1972-81 - comprehensive aerial surveys.
1982-85 - correlation between index counts and total escapement estimates when aerial surveys were complete.
1986-91 - sonar estimate.
Estimates for 1972-85 are rounded to the nearest thousand fish.
[c]Escapement estimates based on comprehensive aerial surveys.
Estimates for 1972-88 are rounded to the nearest thousand fish.
[d]Minimal estimate based on incomplete data.
[e]Preliminary.

Table 27. Peak aerial live counts of chinook salmon in selected index streams and portions of the Nushagak and Mulchatna Rivers, 1967-1991.

Year	Muklung River	Iowithla River	Klutispaw River	King Salmon River	Stuyahok River	Koktuli River	Nushagak River[a]	Mulchatna River[b]	Tot
1967	350	200			2,500	3,300			6,3
68[d]	750	850	310	1,000	2,470	4,220	970	510	11,0
69	520	580	90	670	1,220	1,600	910[c]	680[c]	6,2
70	590	700	320	1,060	1,900	1,500	1,180[c]	880[c]	8,1
71	280	390							6
1972	150	170	280	900	610	1,450	690[c]	510[c]	4,7
73			380	1,470	1,220	950			4,0
74[d]	1,010	860	440	2,000	2,300	3,920	2,340	2,160	15,0
75	660	1,040	670	2,900	2,530	4,080	2,320[c]	1,710[c]	15,9
76[d]	840	1,110	1,180	3,510	3,750	6,710	1,760	2,580	21,4
1977[d]	940	840	650	1,420	2,700	4,630	820	1,980	13,9
78[d]	1,170	1,700	1,940	4,450	4,400	6,730	5,850	2,280	28,5
79[d]	950	1,350	1,040	2,150	3,570	6,260	2,880	1,730	19,9
80	1,600	2,310[c]	970	4,500	7,200	10,620	5,300[c]	3,920[c]	36,4
81	2,260	2,630	1,650	2,950	5,980	9,960	4,960[c]	3,670[c]	34,0
1982	790	2,520	350	8,390	3,640	6,780	4,380[c]	3,240[c]	30,0
83[d]	1,830	2,430	2,090	5,990	2,910	8,060	6,330	4,260	33,9
84[d]	1,300	1,080	770	1,780	2,010	2,860	2,800	1,060	13,6
85	1,250	1,610	1,950	4,460	2,690	4,940	3,420[c]	2,390[c]	22,7
86	230	270	170	380	520	290	380[c]	260[c]	2,5
1987	160	140	340	570	280	440	390[c]	270[c]	2,5
88	430	550	780	1,380	2,040	2,580	1,800	710	10,2
89					190[c]	240[c]			
90	60	120	340	900	830	3,390	630	800	7,0
91[f]									
Mean[g]	820	1,010	800	2,520	2,490	4,140	2,620	1,810	16,2
Percent	5.1	6.2	4.9	15.5	15.4	25.6	16.2	11.2	100

[a]Includes that section of Nushagak River between Nuyakuk River and King Salmon River.
[b]Includes that section of Mulchatna River between Koktuli River and Mosquito Creek
[c]These numbers are proportional estimates rather than aerial live counts and are based on the mean proportion of fish counted in these areas during years in which aerial coverage was complete.
[d]Years in which aerial survey coverage was complete.
[e]Minimal estimate - very poor survey conditions. These numbers are included in th mean.
[f]No surveys conducted.
[g]Includes only those years for each system where aerial survey coverage was complete.

Table 28. Inshore commercial catch and escapement of chum salmon in the Nushagak and Togiak Districts, in numbers of fish, Bristol Bay, 1972-1991.[a]

Year	Nushagak District			Togiak District		
	Catch	Escapement[b]	Total Run	Catch	Escapement[c]	Total Run
1972	310,126	195,000	505,126	178,885	170,000	348,885
73	336,331	200,000	536,331	195,431	163,000	358,431
74	157,941	100,000	257,941	80,710	161,000	241,710
75	152,891	80,000	232,891	87,058	114,000	201,058
76	801,064	500,000	1,301,064	153,559	392,000	545,559
1977	899,701	609,000	1,508,701	270,649	496,000	766,649
78	651,743	293,000	944,743	274,967	396,000	670,967
79	440,279	166,000	606,279	219,942	293,000	512,942
80	681,930	969,000	1,650,930	299,682	415,000	714,682
81	795,143	177,000	972,143	229,886	331,000	560,886
1982	434,817	256,000	690,817	151,000	86,000	237,000
83	725,060	164,000	889,060	322,691	165,000	487,691
84	850,114	362,000	1,212,114	336,660	204,000	540,660
85	396,740	288,000	684,740	203,302	212,000	415,302
86	488,375	168,275	656,650	270,057	330,000	600,057
1987	416,476	147,433	563,909	419,425	361,000	780,425
88	371,196	186,418	557,614	470,132	412,000	882,132
89	523,903	377,512	901,415	203,178	143,890	347,068
90	306,452[d]	329,793	636,245	115,711[d]	67,460	183,171
91	465,582[d]	252,436	718,018	249,113[d]	149,210	398,323
20-Year Ave.	510,293	291,043	801,337	236,602	253,078	489,680
1972-81 Ave.	522,715	328,900	851,615	199,077	293,100	492,177
1982-91 Ave.	497,872	253,187	751,058	274,127	213,056	487,183

[a]Escapements were estimated from the following:
1972 - average catch/escapement ratio for 1968-69 and 1973-81;
1973-74 - tower enumeration and aerial survey data;
1975-78 - aerial survey data;
1979-91 - adjusted sonar estimate from Portage Creek site.
Estimates for 1972-85 are rounded to the nearest thousand fish.
[b]Escapement estimates based on aerial surveys; however, surveys were not conducted in 1986 due to budget constraints. Estimate based on catch/escapment proportion using most recent 10-year average data.
Estimates for 1972-88 rounded to the nearest thousand fish.
[c]Escapement estimates supersede those previously reported.
[d]Preliminary.

Table 29. Total escapement estimates of pink salmon, Nushagak and Togiak Districts, 1962-1990.[a]

Year	Nushagak District[b]	Togiak District[c]
1962	543,000	
1964	910,560	
1974	585,520	8,620
1976	863,430	37,570
1978	9,386,480	150,000
1980	2,785,200	102,820
1982	1,656,660	44,300
1984	2,926,450	269,950
1986	72,190[d]	80,000[e]
1988	494,610[d]	142,500[e]
1990	801,730[d]	207,000
Mean	1,911,440	115,860

[a]Includes Wood, Igushik, Snake, Nushagak, & Nuyakuk Rivers, and Ice, Youth, & Sunshine Creeks, unless otherwise noted.
[b]Includes Togiak, Matogak, Osviak, & Slug Rivers.
[c]Only those years of comprehensive aerial coverage are included; even years only; all counts rounded to the nearest 10 fish.
[d]Sonar estimate of Nushagak-Mulchatna Rivers only.
[e]Togiak River estimate only.

Table 30. Peak aerial live counts and total escapement estimates of sockeye salmon, Togiak District, 1991.

Stream	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor[a]	Number
TOGIAK SECTION				
Togiak Tower				254,683
Togiak River (Mainstem)	8/16	7,990	2.0	15,980
Gechiak Lake System	8/16	1,640	2.0	3,280
Pungokepuk Lake System	8/16	1,220	2.0	2,440
Nayorurun River[b]				
Kemuk River[b]				
Ongivinuck Lake System	8/16	1,010	2.0	2,020
Subtotal		11,860		278,403
KULUKAK SECTION				
Kulukak River[c]	8/16	3,050	2.0	6,100
Kulukak Lake	7/22	5,600	2.0	11,200
Tithe Creek Ponds[c]	8/16	3,320	2.0	6,640
Subtotal		11,970		23,940
MATOGAK, OSVIAK, and CAPE PIERCE SECTIONS				
Matogak River[c]	8/18	860	2.0	1,720
Osviak River[c]	8/18	2,530	2.0	5,060
Slug River	8/19	560	2.0	1,120
Subtotal		3,950		7,900
OTHER RIVERS				
Quigmy River	8/21	35	2.0	70
Negukthlik River	8/21	3,400[d]	1.5	5,100
Ungalikthluk River	8/21	2,650	2.0	5,300
Subtotal		6,085		10,470
Total		33,865		320,713

[a]Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.
[b]No aerial surveys conducted.
[c]USFWS observer count.
[d]Count includes 2,800 fish schooled in connection.

Table 31. Aerial estimates of sockeye salmon escapements, Togiak District, 1972-1991.[a]

Year	Togiak River and Tributaries[b]	Kulukak Systems[c]
1972	4,500	3,400
73	11,200	8,000
74	20,600	4,900
75	19,600	8,600
76	31,200	11,200
1977	15,600	40,100
78	30,600	33,900
79	23,700	26,600
80	50,700	45,700
81	39,700	58,800
1982	25,300	52,800
83	13,200	27,000
84	30,900	49,800
85	8,800	36,600
86	35,000	42,800
1987	28,600	37,800
88	32,400	31,700
89	19,800	10,800
90	47,100	49,600
91	23,700	23,900
1972-91 Mean (20-Year)	25,610	30,200
1972-81 Mean (10-Year)	24,740	24,120
1982-91 Mean (10-Year)	26,480	36,280

[a]All counts are rounded to the nearest hundred.
[b]Estimates do not include fish spawning above the counting tower (Togiak Lake outlet); estimates for Togiak River proper are unavailable prior to 1974; estimates for Ungalikthluk, Osviak, Matogak, & Slug Rivers are not included in the 1977-91 data as reported earlier in Bristol Bay Data Reports 73 and 81.
[c]Includes Kulukak River, Kulukak Lake, and Tithe Creek Ponds.

Table 32. Peak aerial live counts of sockeye salmon, Togiak River drainage, 1972-1991.

Year	Togiak Mainstem	Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
1972		200	350			1,700	2,250
1973		1,800	1,900			1,900	5,600
1974	6,000	1,700	1,100			1,500	10,300
1975	6,100	830	1,450			1,380	9,760
1976	11,000	3,300	2,600			2,200	19,100
1977	2,200	500	2,000			3,100	7,800
1978	10,000	2,020	1,200			4,620	17,840
1979	7,100	520	750			2,800	11,170
1980	18,600	3,200	2,500	500	3,200	2,000	30,000
1981	14,100	2,700	3,150			3,400	23,350
1982	2,300	3,600	2,500	0	100	4,800	13,300
1983	4,800	1,100	700	0	0	1,200	7,800
1984	10,550	2,800	2,450	0	0	2,300	18,100
1985	1,800	400	500	0	0	1,700	4,400
1986	13,500						13,500
1987	5,200	3,600	600	0	0	4,900	14,300
1988	9,400	2,000	1,100	0	0	3,700	16,200
1989	7,600	1,500	630			150	9,880
1990	8,770	5,720	5,980	0	2,550	1,190	24,210
1991	7,990	1,640	1,220			1,010	11,860
Mean	8,167	2,059	1,720	63	731	2,397	15,138[a]
Percent	54.0	13.6	11.4	0.4	4.8	15.8	100.0

[a]Sum of means for all streams.

Table 33. Peak aerial live counts of sockeye salmon, Togiak District, 1972-1991.

Year	Togiak River[a]	Kulukak River[b]	Tithe Creek Ponds	Quigmy River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1972	2,250	200	1,500							3,950
1973	5,600	1,600	2,400							9,600
1974	10,300	750	1,700							12,750
1975	9,760	780	3,500							14,040
1976	19,100	1,460	4,150							24,710
1977	7,800	6,400	18,200		200	2,000	2,700		1,700	39,000
1978	17,840	8,100	11,800						1,000	38,740
1979	11,170	4,600	10,800		200	200		600	700	28,270
1980	30,000	12,200	14,200		500	200	1,900			63,500[c]
1981	23,350	15,700	18,250		700	6,400	5,900	3,900	12,800	87,000
1982	13,300	11,900	19,300		0	1,000	5,500	300	2,400	53,700
1983	7,800	8,430	2,720		80	20	2,000	230	940	22,220
1984	18,100	7,400	14,000		200	6,800		100	5,200	51,800
1985	4,400	6,700	11,600		0	200	2,300	260	1,310	26,770
1986	13,500	10,900	14,000							38,400
1987	14,300	10,500	8,400							33,200
1988	16,200	12,600	3,250	250	100	380	5,880	200	2,700	41,560
1989	9,880	2,920	2,500					5,000		20,300
1990	24,140	10,600	14,200	100	400	2,200	3,540	9,700	3,800	68,680
1991	11,860	8,650	3,320	35	860	2,530	560	3,400	2,650	33,865
Mean	15,138	9,173	8,990	128	295	1,994	3,364	2,369	3,200	44,651[d]
Percent	33.9	20.5	20.1	0.3	0.7	4.5	7.5	5.3	7.2	100.0

[a]Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River. See Table 31.
[b]Includes Kulukak Lake. Counts prior to 1977 include Kulukak Lake only and are not included in the mean.
[c]Includes a combined count for the Negukthlik and Ungalikthluk of 4,500 fish.
[d]Sum of means for all streams.

Table 34. Peak aerial live counts and total escapement estimates of chinook salmon, Togiak District, 1991.

Stream	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor[a]	Number
TOGIAK SECTION				
Togiak River Mainstem				
A	8/6	505	3	1,515
B	8/6	165	2.5	413
C	8/6	475	2.5	1,188
D	8/6	225	2.5	563
E	8/6	520	2.5	1,300
F	8/6	455	2.5	1,138
Subtotal		2,345		6,115
Gechiak River	8/6	460	2.5	1,150
Pungokepuk River	8/6	105	2.5	263
Nayorurun River	8/6	90	2.5	225
Kemuk River	8/6	100	2.5	250
Ongivinuck River	8/7	150	2.5	375
Section Total		3,250	2.5	8,378
KULUKAK SECTION				
Kulukak River	8/7	285	2.5	713
MATOGAK, OSVIAK, and CAPE PIERCE SECTIONS				
Matogak River	7/30	75	2.5	188
Osviak River	7/30	100	2.5	250
Slug River[b]		—		—
Section Totals		175		438
OTHER RIVERS				
Quigmy River	7/30	25	2.5	63
Negukthlik River	8/21	1,175	2.5	2,938
Ungalikthluk River	8/7	55	2.5	138
Subtotal		1,255		3,138
Grand Total		4,965		12,667

[a]Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.
[b]No aerial surveys conducted.

Table 35. Peak aerial live counts of chinook salmon, Togiak River drainage, 1972-1991.

Year	Togiak River Section[a]						Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuk River	Total
	A	B	C	D	E	F						
1972	250	400	610	320	290	620	1,320	200	210	170	220	4,610
1973	210	370	560	270	530	580	470	110	220	140	220	3,680
1974	610	650	830	300	570	860	620	200	120	160	180	5,100
1975	280	240	240	160	210	760	350	240	140	580	470	3,670
1976	210	250	510	260	450	790	550	350	270	290		3,930
1977							1,190	500	230	120	120	2,160
1978	940	1,240	1,390	810	1,060	1,850	2,150	590	780	220	220	11,250
1979	370	250	330	150	560	890	1,060	360	250	170	220	4,610
1980	180	120	340	230	120	140	910	200	510	170	190	3,110
1981	420	390	500	200	300	740	980	310	370	390	290	4,890
1982					80	320	470	170	190	130	470	1,830
1983	120	220	370	290	360	850	820	240	340	430	350	4,390
1984	250	560	900	560	820	1,920	760	580	270	580	430	7,630
1985	270	320	640	340	470	970	470	250	290	310	460	4,790
1986	150	80	160	30	110	350						880
1987	20	70	170	120	200	480	610	180	100	120	320	2,390
1988	70	70	160	160	170	710	390	180	60	70	90	2,130
1989	10	30	370			940	190	80			40	1,660
1990	230	170	680	365	805	1,085	370	125	75	400	10	4,315
1991	505	165	475	225	520	455	460	105	90	100	150	3,250
Mean	283	311	513	282	424	806	744	262	251	253	247	4,375[b]
Percent	6.5	7.1	11.7	6.4	9.7	18.4	17.0	6.0	5.7	5.8	5.7	100.0

[a]Section A: Togiak Bay - Gechiak River
Section B: Gechiak River - Pungokepuk River
Section C: Pungokepuk River - Nayorurun River
Section D: Nayorurun River - Kemuk River
Section E: Kemuk River - Ongivinuck River
Section F: Ongivinuck River - Togiak Lake

[b]Sum of means for all streams.

Table 36. Peak aerial live counts of chinook salmon, Togiak District, 1972-1991.

Year	Togiak River[a]	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1972	4,610		650				120	160	5,540
1973	3,680		440				280	30	4,430
1974	5,100		510				150	30	5,790
1975	3,670		1,100				220	80	5,070
1976	3,930		1,080		100		380	30	5,520
1977	2,160		1,480	60	120		440	40	4,300
1978	11,250		2,720	150	250		1,020	110	15,500
1979	4,610	20	2,260	100	210		850	130	8,180
1980	3,110	0	700	70	40		260	160	4,340
1981	4,890	0	1,290	470	1,730	350	1,460	180	10,370
1982	1,830	90	1,690	290	320		1,600	280	6,100
1983	4,390	40	2,460	190	120		1,080	260	8,540
1984	7,630	30	1,190	150	360		680	20	10,060
1985	4,790	0	540	100	50		80	90	5,650
1986	880								880
1987	2,390		300	30	40		660	80	3,500
1988	2,130	10	490	0	40	0	650	170	3,490
1989	1,660		740				560		2,960
1990	4,315	30	635	75	60	0	930	25	6,070
1991	3,250	25	285	75	100		1,175	55	4,965
Mean	4,375	25	1,082	135	253	117	663	107	6,756[b]
Percent	64.7	0.4	16.0	2.0	3.7	1.7	9.8	1.6	100.0

[a]Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River. See Table 34.
[b]Sum of means for all streams.

Table 37. Peak aerial live counts and total escapement estimates of chum salmon, Togiak District, 1991.

Stream	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor[a]	Number
TOGIAK SECTION				
Togiak River Mainstem				
A	8/6	10,200	2.5	25,500
B	8/6	3,900	2.0	7,800
C	8/6	2,800	2.0	5,600
D	8/6	600	2.0	1,200
E	8/6	5,500	2.0	11,000
F	8/6	6,000	2.0	12,000
Subtotal		29,000		63,100
Gechiak River	8/6	2,300	2.0	4,600
Pungokepuk River	8/6	500	2.0	1,000
Nayorurun River	8/6	3,500	2.5	8,750
Kemuk River	8/6	800	2.5	2,000
Ongivinuck River	8/7	3,480	2.5	8,700
Section Total		39,580		88,150
KULUKAK SECTION				
Kulukak River	8/7	9,540	2.0	19,080
MATOGAK, OSVIAK, and CAPE PIERCE SECTIONS				
Matogak River	7/30	4,730	2.0	9,460
Osviak River	7/30	8,700	2.0	17,400
Slug River[b]				
Section Totals		13,430		26,860
OTHER RIVERS				
Quigmy River	7/30	4,420	2.0	8,840
Negukthlik River	8/7	120	2.0	240
Ungalikthluk River	8/7	3,020	2.0	6,040
Subtotal		7,560		15,120
Grand Total		70,110		149,210

[a]Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor surveys conditions, bad weather, etc.
[b]No aerial surveys conducted.

Table 38. Peak aerial live counts of chum salmon, Togiak River drainage, 1972-1991.

Year	Togiak River[a] A	B	C	D	E	F	Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
1972	11,800	1,400	800	100	2,900	4,300	4,600	1,300	1,500	100	1,800	30,600
1973	9,500	2,700	1,000	100	4,900	4,500	3,100	1,400	3,900	100	2,400	33,600
1974	15,900	3,900	3,800	300	4,400	6,900	4,300	2,300	1,700	100	2,600	46,200
1975	5,500	5,200	1,600	500	3,000	19,500	2,600	700	1,100	1,400	1,300	42,400
1976	21,100	12,600	8,400	2,600	13,000	2,700	9,800	2,300	13,000	900	400	86,800
1977	12,000	8,000	10,900	8,000		15,100	13,600	4,900	22,100	3,100	2,400	100,100
1978	24,500	7,400	7,500	1,600	15,200	3,300	6,300	2,500	7,300	1,800	8,100	85,500
1979	14,000	2,800	3,300	800	6,600	10,400	3,500	1,000	2,500	500	200	45,600
1980	41,300	11,000	9,200	900	6,000	3,100	10,200	2,700	10,100	800	3,500	98,800
1981	11,800	4,500	2,400	1,000	3,000	6,000	3,100	500	4,300	1,700	4,200	42,500
1982				200	1,200	2,500	500	400	1,300	100	1,000	7,200
1983	8,160	3,050	3,780	1,100	2,780	6,070	150	140	5,560	570	3,790	35,150
1984	3,900	6,300	800	0	2,600	6,400	3,700	2,000	4,200	700	3,500	34,100
1985	8,300	6,500	3,200	900	6,700	10,200	4,100	600	9,600	1,800	8,300	60,200
1986[b]												
1987	12,000	9,400	2,700	500	13,200	33,000	2,600	1,200	4,100	700	13,100	92,500
1988	10,000				4,900	3,800	3,700	5,000	3,500	200	3,800	34,900
1989		2,600	2,100		5,000	8,100	290	700			1,200	19,990
1990	2,200	1,275	1,350	400	650	4,200	3,150	1,150	3,400	250	125	18,150
1991	10,200	3,900	2,800	600	5,500	6,000	2,300	500	3,500	800	3,480	39,580
Mean	13,068	5,443	3,861	1,153	5,641	8,214	4,294	1,647	5,703	868	3,431	53,323[c]
Percent	24.5	10.2	7.2	2.2	10.6	15.4	8.1	3.1	10.7	1.6	6.4	100.0

[a]Section A: Togiak Bay - Gechiak River
Section A: Togiak Bay - Gechiak River
Section B: Gechiak River - Pungokepuk River
Section C: Pungokepuk River - Nayorurun River
Section D: Nayorurun River - Kemuk River
Section E: Kemuk River - Ongivinuck River
Section F: Ongivinuck River - Togiak Lake
[b]No aerial surveys conducted.
[c]Sum of means for all streams.

Table 39. Peak aerial live counts of chum salmon, Togiak District, 1972-1991.

Year	Togiak River[a]	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1972	30,600	3,700	6,800	4,000	13,400	8,000	1,600	10,800	78,900
1973	33,600		7,400	3,400	9,000	2,700	3,500	1,400	61,000
1974	46,200	1,400	7,900	2,100	5,600	1,100	3,000	8,400	75,700
1975	42,400	1,800	6,000	2,600	9,000	3,000	2,300	4,700	71,800
1976	86,800	6,600	14,600	9,600	26,100	7,100	8,000	15,000	173,800
1977	100,100	5,800	21,300	15,300	31,200	2,800	20,000	20,500	217,000
1978	85,500	9,400	24,200	15,000	17,500	6,400	7,600	8,000	173,600
1979	45,600	11,000	16,400	13,400	36,200	4,000	3,800	6,600	137,000
1980	98,800	2,700	27,300	5,700	29,500	6,700	18,500	15,000	204,200
1981	42,500	10,800	11,200	21,700	53,000	3,900	3,800	14,600	161,500
1982	7,200	1,300	8,300	3,100	5,500	2,400	160	1,270	29,230
1983	35,150	4,900	12,960	7,600	11,900	1,210	300	7,360	81,380
1984	34,100	6,300	8,500	10,200	18,400		2,100	3,000	82,600
1985	60,200	1,800	7,800	2,860	5,460	8,800	130	14,650	101,700
1986[b]									
1987	92,500	1,500	22,000	2,300	2,160				120,460
1988	34,900	10,800	35,000	12,000	17,400	7,600	400	11,300	129,400
1989	19,990	2,820	5,580	7,450	4,900		560		41,300
1990	18,150	555	5,550	1,475	2,300	3,650	750	1,300	33,730
1991	39,580	4,420	9,540	4,730	8,700		120	3,020	70,110
Mean	53,323	4,866	13,596	7,606	16,169	4,624	4,257	8,641	113,083[c]
Percent	47.2	4.3	12.0	6.7	14.3	4.1	3.8	7.6	100.0

[a]Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River. See Table 37.
[b]No aerial surveys conducted.
[c]Sum of means for all streams.

Table 40. Peak aerial live counts and total escapement estimates of coho salmon, Togiak District, 1991.

Stream	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor[a]	Number
TOGIAK SECTION				
Togiak River Mainstem				
A	9/6	4,900		
B	9/6	400		
C	9/6	700		
D	9/6	600		
E	9/6	1,680		
F	9/6	140		
Subtotal		8,420		
Gechiak River[b]	9/6			
Pungokepuk River[b]	9/6			
Nayorurun River[b]	9/6			
Kemuk River[b]	9/6			
Ongivinuck River	9/6	100		
Section Total		8,520	3	25,560
KULUKAK SECTION				
Kulukak River	9/6	4,200	3	12,600
Total		12,720		38,160

[a]Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey coonditions, bad weather, etc.
[b]No aerial surveys conducted

Table 41. Peak aerial live counts of coho salmon, Togiak River drainage, 1980-1991.

Year	Togiak River A	B	C	D	E	F	Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
1980	3,620	1,010	1,740	1,270	5,080	1,860	3,460	760	1,310	860	740	21,710
1981	9,280	580	100	800	370	750	520	360	230	210	1,300	14,500
1982	2,200	1,500	150	100	1,400	1,700	1,930	1,740	510	200	11,870	23,300
1983[b]												
1984	1,440	1,190	200	120	620	1,480	4,750	2,240	990	1,110	6,140	20,280
1985	800[c]	660[c]	110[c]	70[c]	150	820	1,340	750	40	80	6,250	11,070
1986			60	400	100	400					2,560	3,520
1987	340	500	250	200	240	530	1,020	70			1,060	4,210
1988	950	370		140	210	360	1,530				4,100	7,660
1990	1,650	390	400	0	540	660	920	450	260	130	1,730	7,130
1991[d]	4,900	400	700	600	1,680	140					100	8,520
Mean	2,535	775	376	344	968	951	1,934	910	557	432	3,972	13,754[e]
Percent	18.4	5.6	2.7	2.5	7.0	6.9	14.1	6.6	4.0	3.1	28.9	100.0

[a]Section A: Togiak Bay - Gechiak River
Section B: Gechiak River - Pungokepuk River
Section C: Pungokepuk River - Nayorurun River
Section D: Nayorurun River - Kemuk River
Section E: Kemuk River - Ongivinuck River
Section F: Ongivinuck River - Togiak Lake

[b]No aerial surveys conducted.

[c]Proportional estimates based on 1984 data.

[d]Timing of aerial surveys did not coincide with the period of peak spawning activity, and therefore, 1991 counts were not included in the mean or percent.

[e]Sum of means for all streams.

Table 42. Peak aerial live counts of coho salmon, Togiak District, 1980-1991.

Year	Togiak River[a]	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1980	21,710		10,300						32,010
1981	14,500		3,790				100	840	19,230
1982	23,300		3,380						26,680
1983[b]									
1984	20,280		10,750	1,850	1,080	670			34,630
1985	11,070	200	7,790	610	420				20,090
1986	3,520								3,520
1987	4,210	30	910	440	120			130	5,840
1988	7,660	460	1,840	310	490	470	370	3,170	14,700
1989[b]									
1990	7,130	1,030	5,200	2,680	1,490	810		4,150	22,490
1991[c]	8,520		4,200						12,720
Mean	13,754	430	5,495	1,178	720	650	235	2,073	24,535[d]
Percent	56.1	1.8	22.4	4.8	2.9	2.6	1.0	8.4	100.0

[a]Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River. See Table 40.
[b]No aerial surveys conducted.
[c]Timing of aerial surveys did not coincide with the period of peak spawning activity, and therefore, 1991 counts were not included in the mean or percent.
[d]Sum of means for all streams.

Table 43. Comparison of peak aerial counts of spawning sockeye salmon between observers in western Bristol Bay, August 26, 1991.[a]

Spawning Area	Observer 1	Observer 2
Nuyakuk Lake		
North Beach	610[b]	610
South Beach	290[b]	280
Portage Arm Beach	40[b]	60
Mirror Bay Beach	260[b]	240
Lake Chauekuktuli		
Allen River Beach	3,300[b]	3,400
North Beach	720[b]	780
South Beach	60[b]	65
Shadow Bay Beach	0[b]	0
Aqulukpak River (three passes)	23,000	30,000
	28,000	35,000[b]
	34,000	33,000
Aqulowak River (two passes)	77,000	86,000
	85,000	86,000[b]
Snake Lake		
Snake R.-Eagle Cr. Beach	2,050[b]	2,150
West Shore Beach	1,480[b]	1,090
East Shore Beach	870[b]	930
South Shore Beach	300[b]	410
Amanka Lake		
West Arm Beach	970[b]	780
East Arm Beach	765[b]	900
Ualik Lake Beach	7,920[b]	6,200
Total	266,635	287,895
Percent Difference	-8.0	

[a]Observer 1: T. Brookover; Observer 2: W. Bucher.
[b]Preferred count.

Table 44. Comparison of peak aerial counts of spawning salmon between ADF&G and USF&WS observers, Bristol Bay, 1991.[a]

Location	Date	Chum Salmon		Chinook Salmon		Sockeye Salmon	
		ADF&G	USF&WS	ADF&G	USF&WS	ADF&G	USF&WS
Quigmy River	7/30	4,420[b]	3,010	25[b]	28		
Matogak River	7/30	4,730[b]	4,010	75[b]	76		
Osviak River	7/30	8,700[b]	9,600	85	104[b]	1,020	640
Togiak River							
Gechiak R.-Pungo R.	8/16			80	90	440	610
Twin Hills cutoff	8/16			40	42	200	560
Pungokepuk Lake	8/16					680	570
Tithe Creek Ponds	8/16						3,320[b]
	8/21					3,490	

[a]ADF&G observer: T. Brookover; USF&WS observer: M. Lisac.
[b]Preferred count.

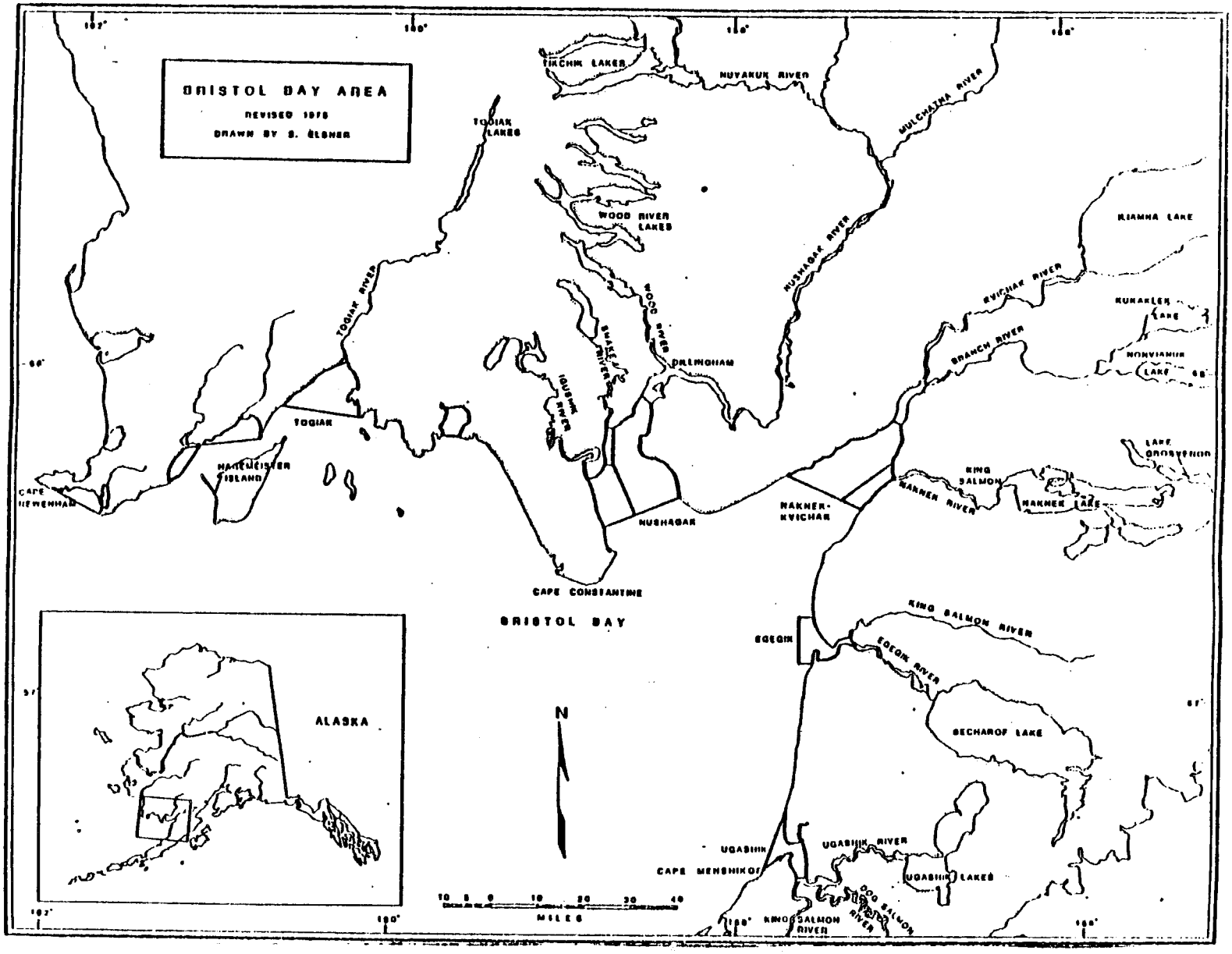

Figure 1. Bristol Bay management area, Alaska.

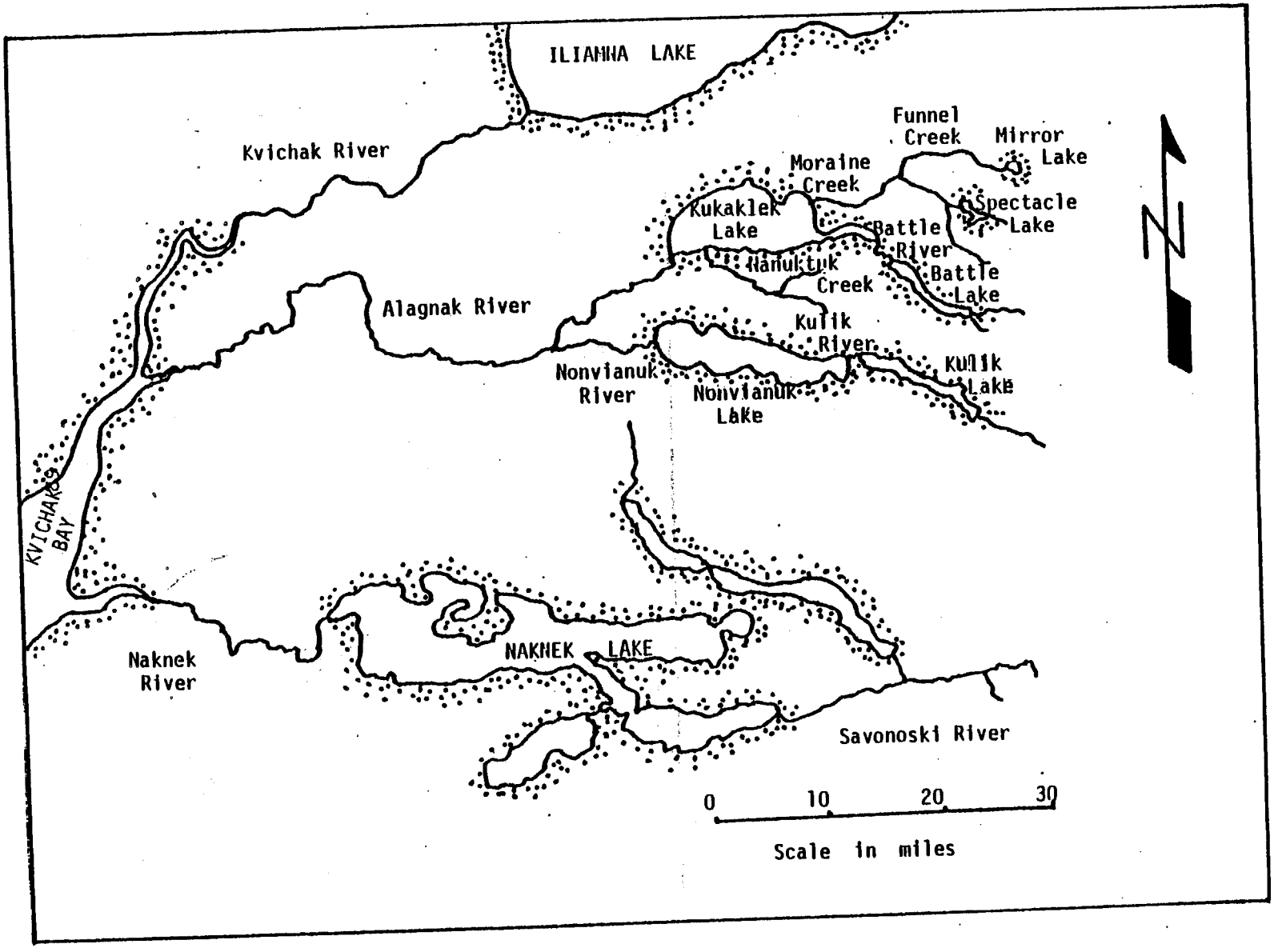

Figure 2. Alagnak River drainage, Bristol Bay, Alaska.

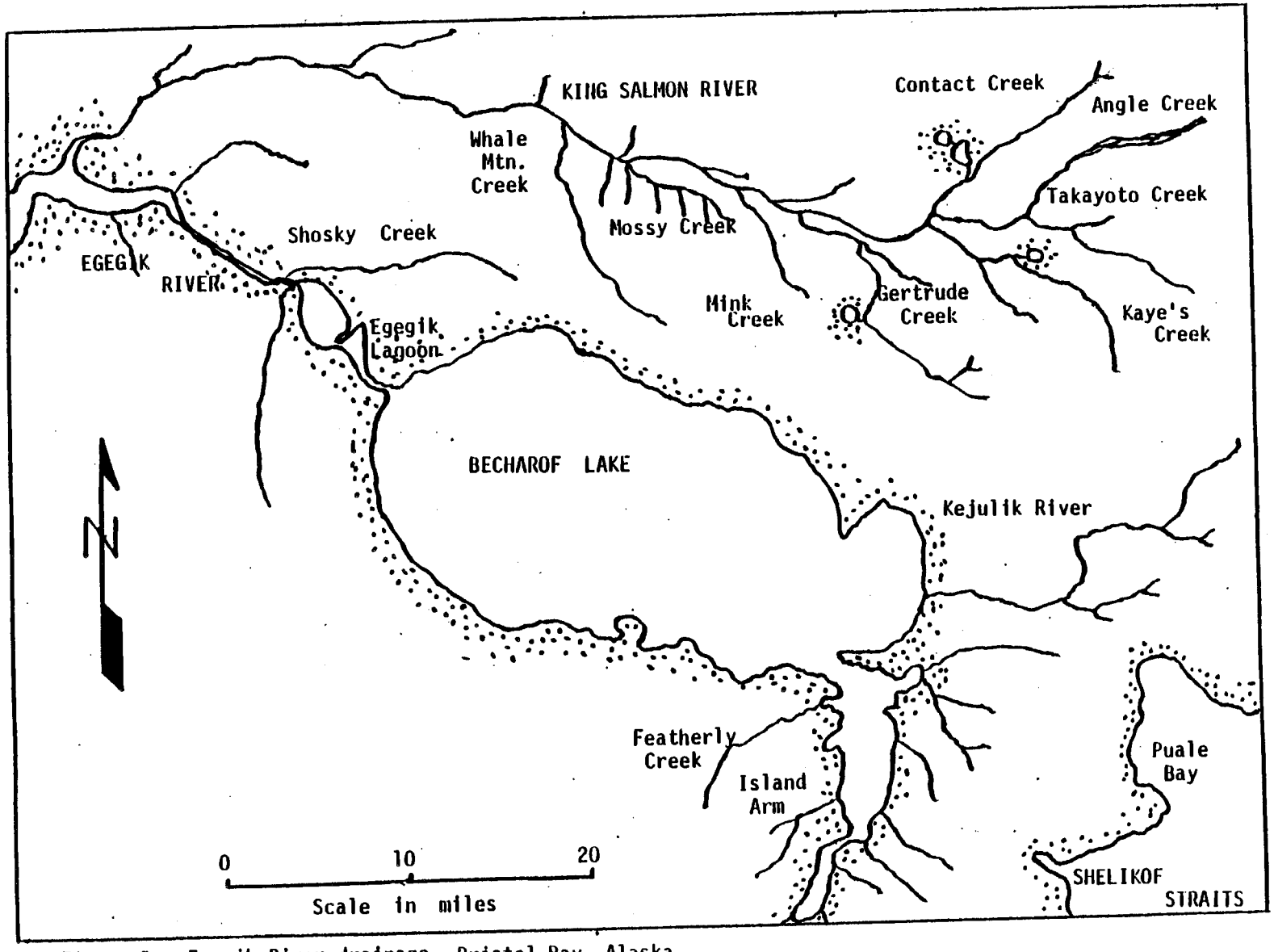

Figure 3. Egegik River drainage, Bristol Bay, Alaska.

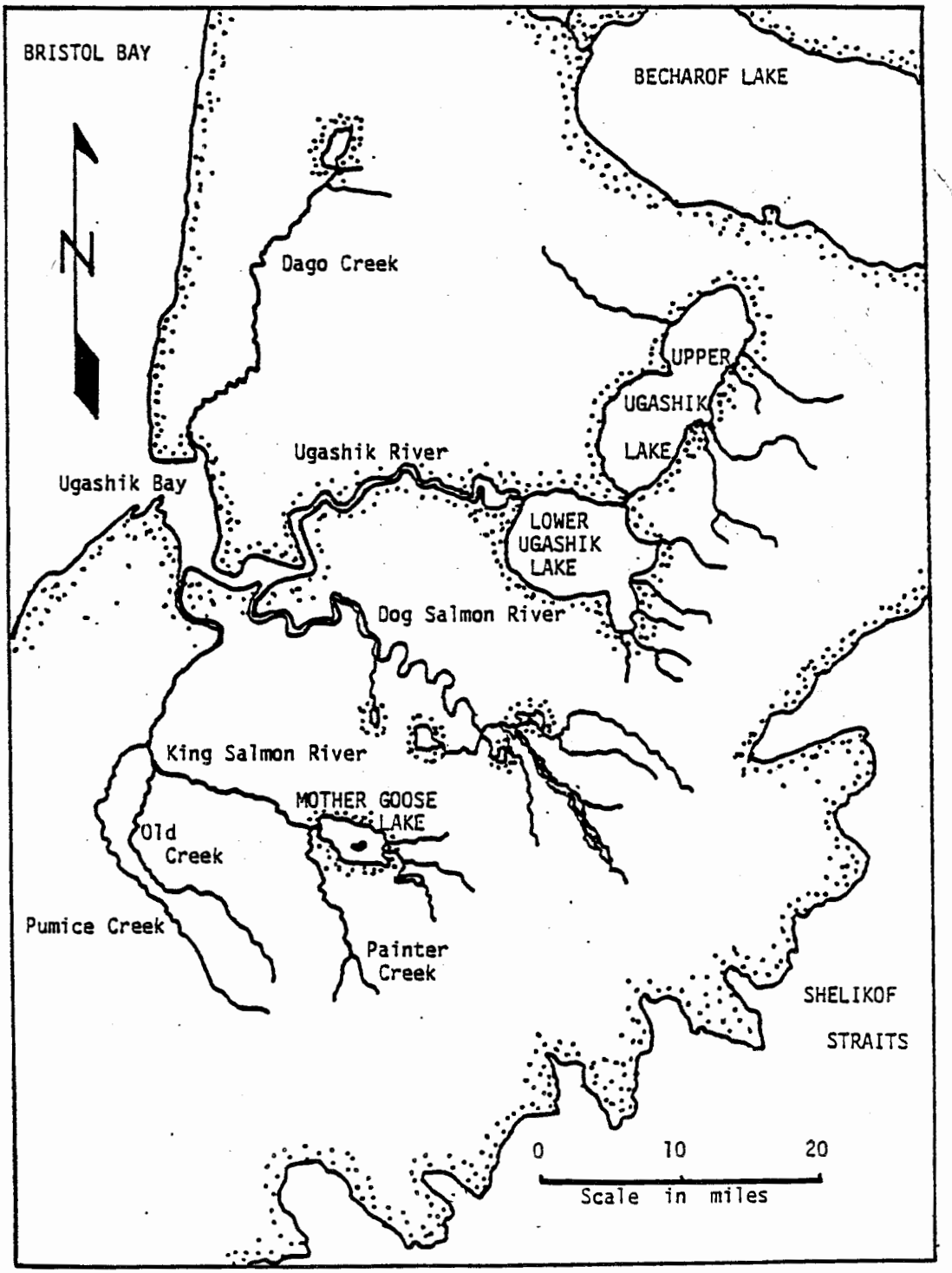

Figure 4. Ugashik River System, Bristol Bay, Alaska.

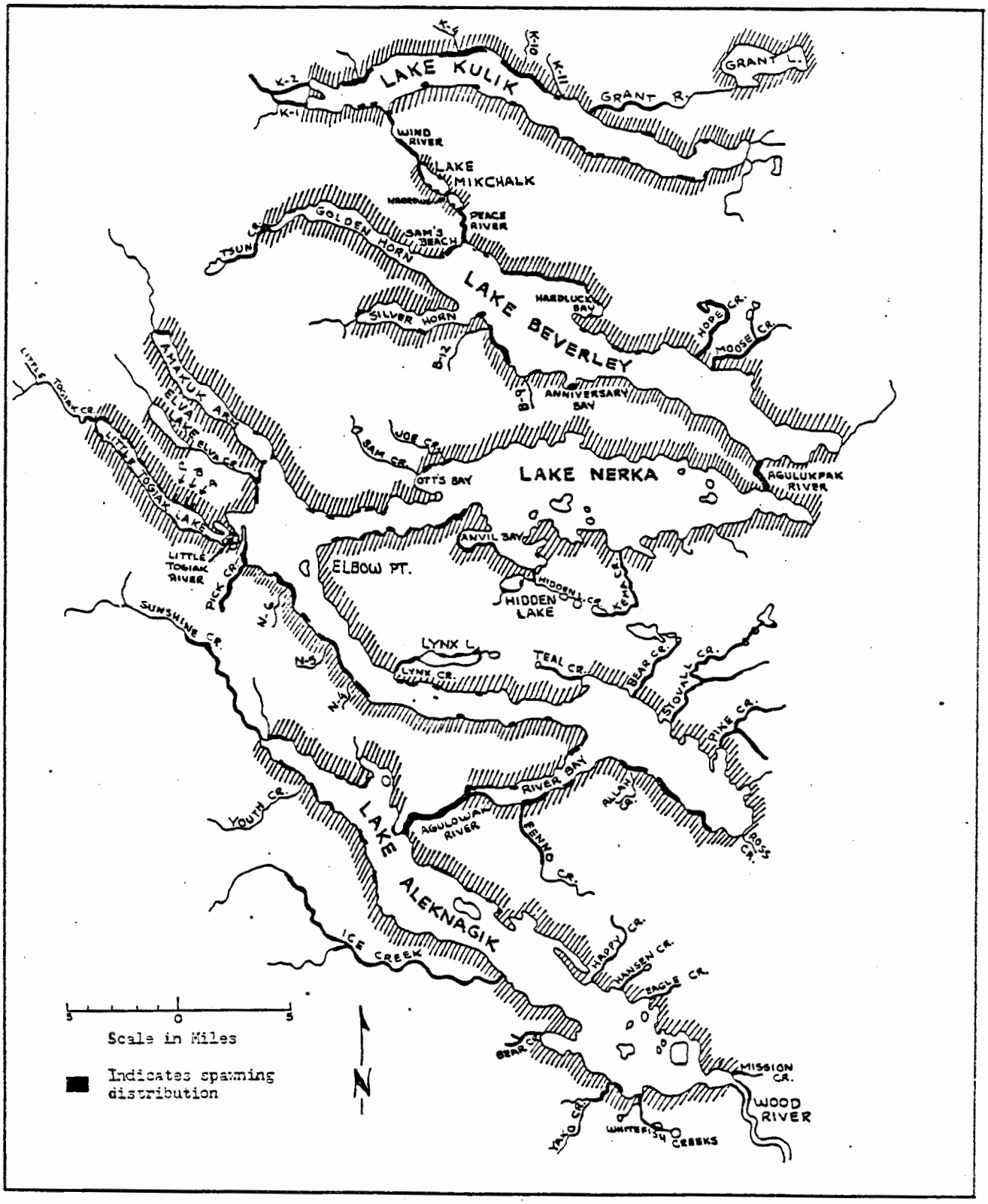

Figure 5. Wood River Lakes system, Bristol Bay, Alaska.

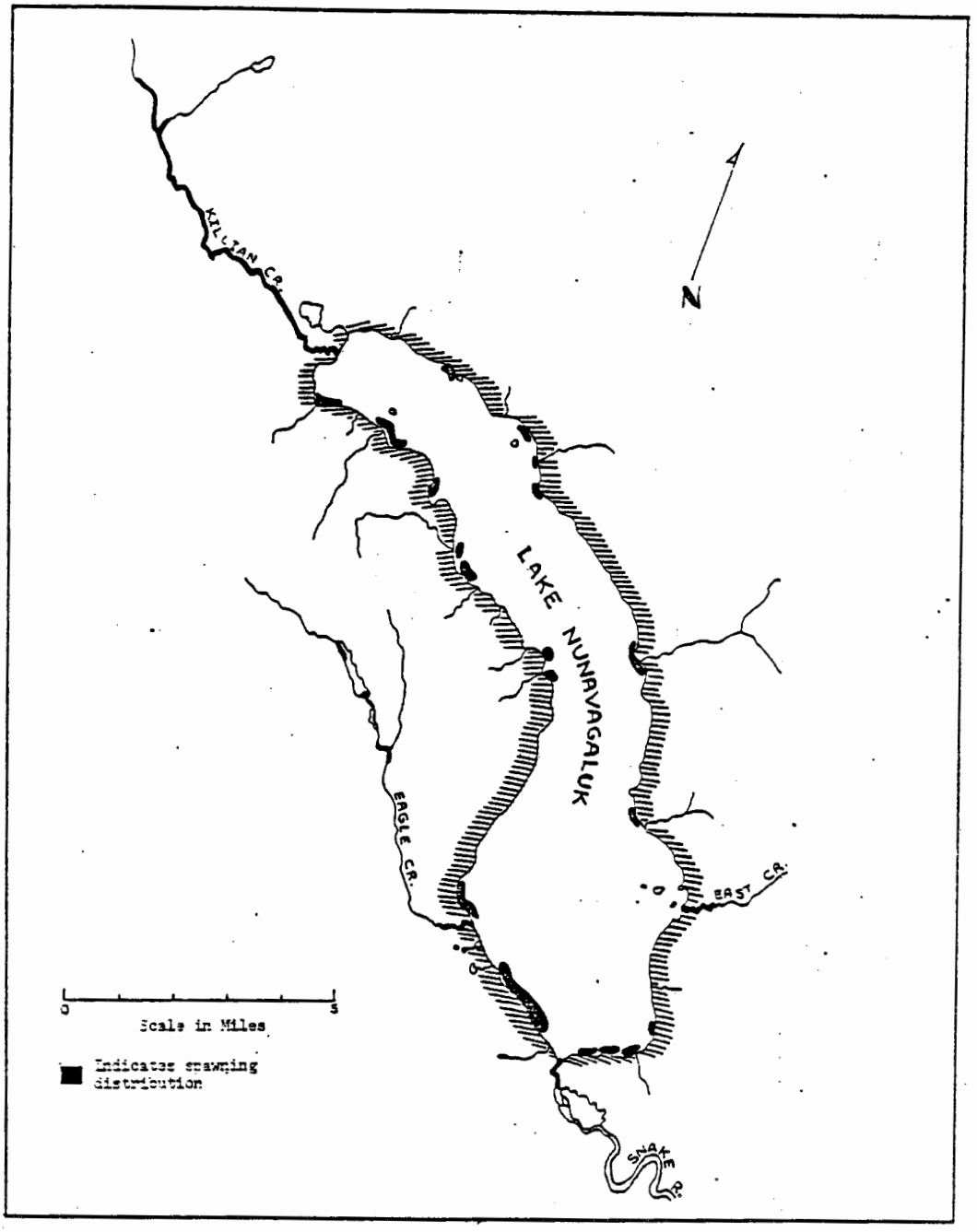

Figure 6. Lake Nunavaugaluk system, Bristol Bay, Alaska.

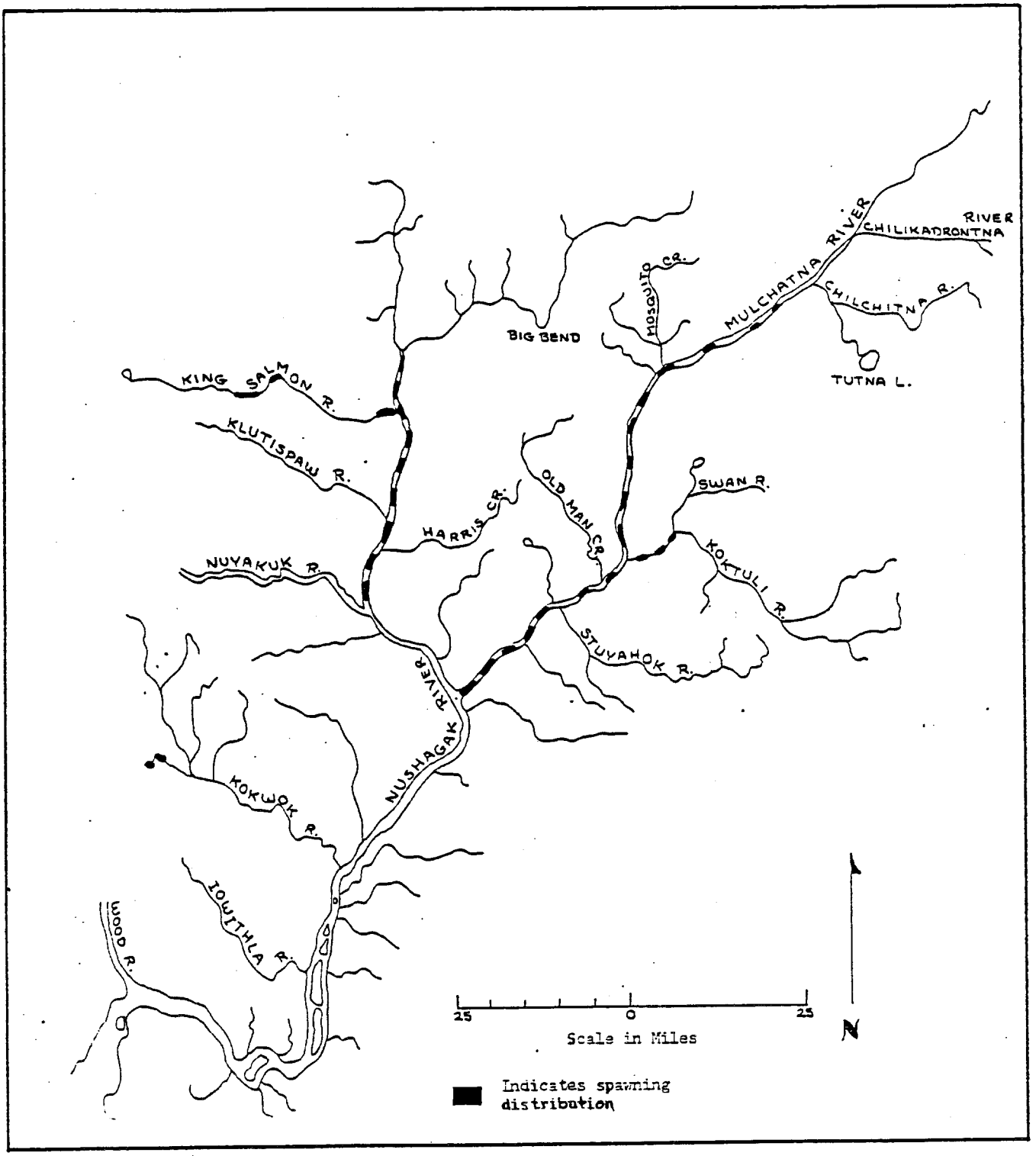

Figure 7. Nushagak-Mulchatna River system, Bristol Bay, Alaska.

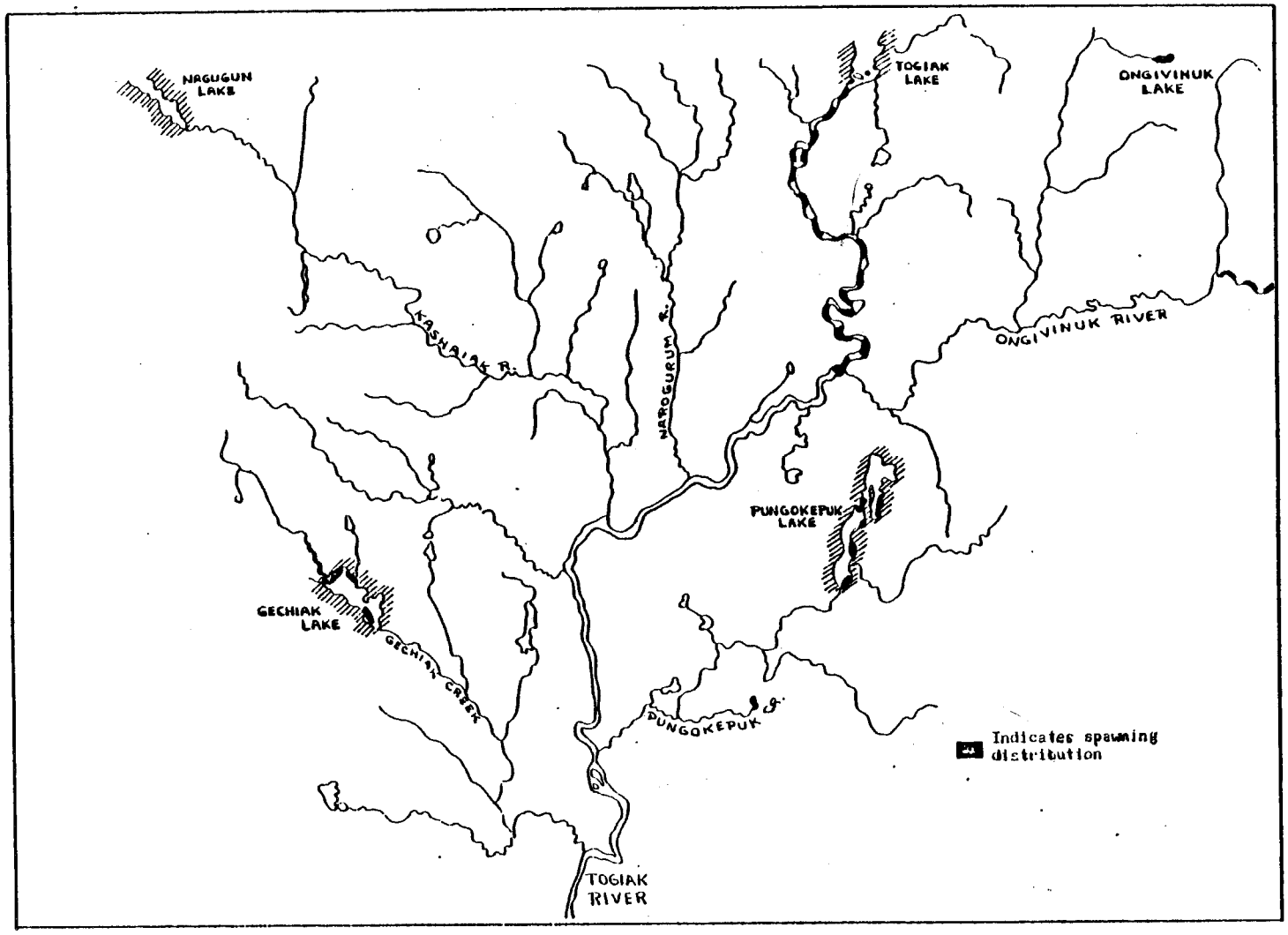

Figure 9. Togiak River system, Bristol Bay, Alaska.

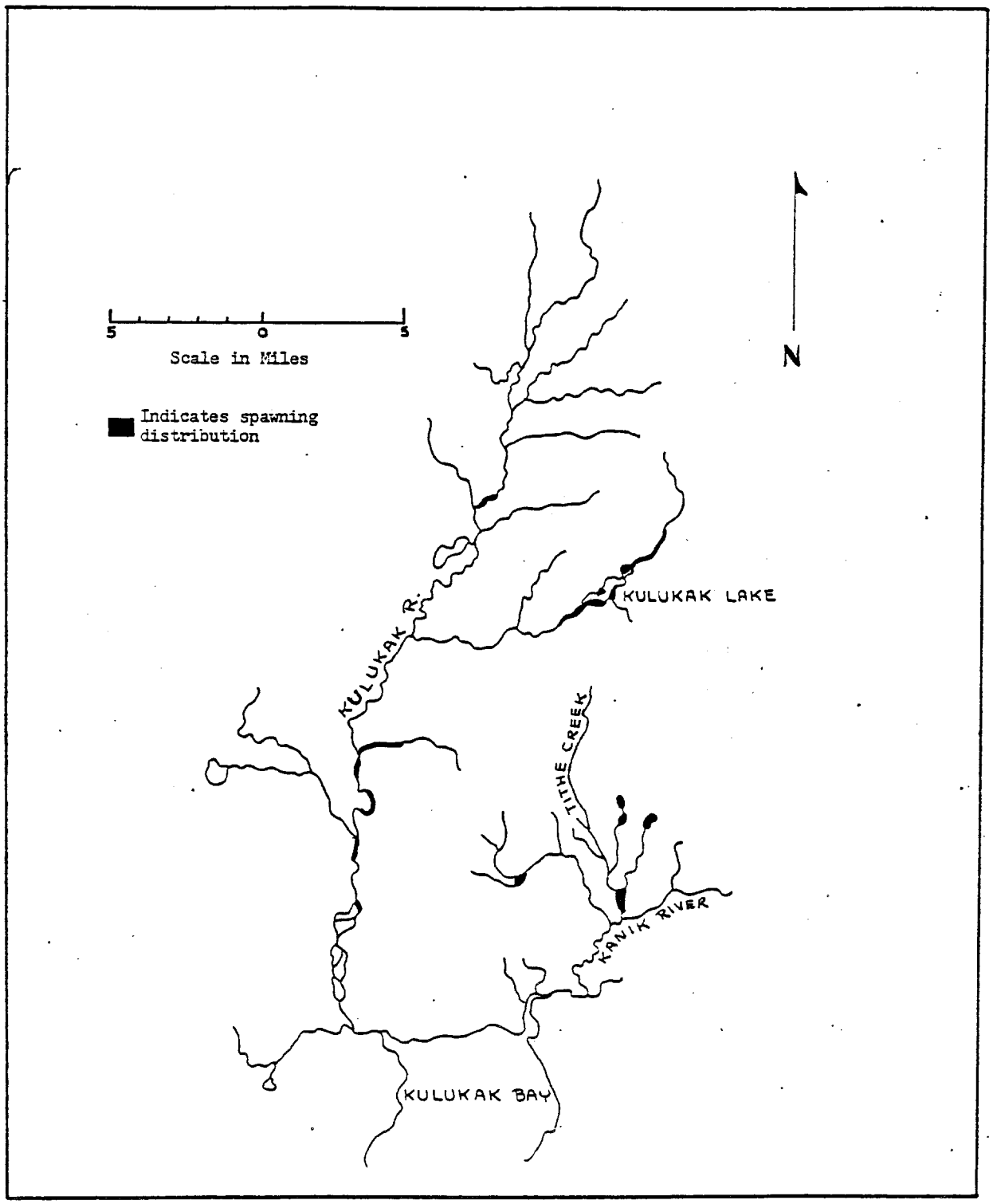

Figure 10. Kulukak River system, Bristol Bay, Alaska.